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United States
Department of
Agriculture

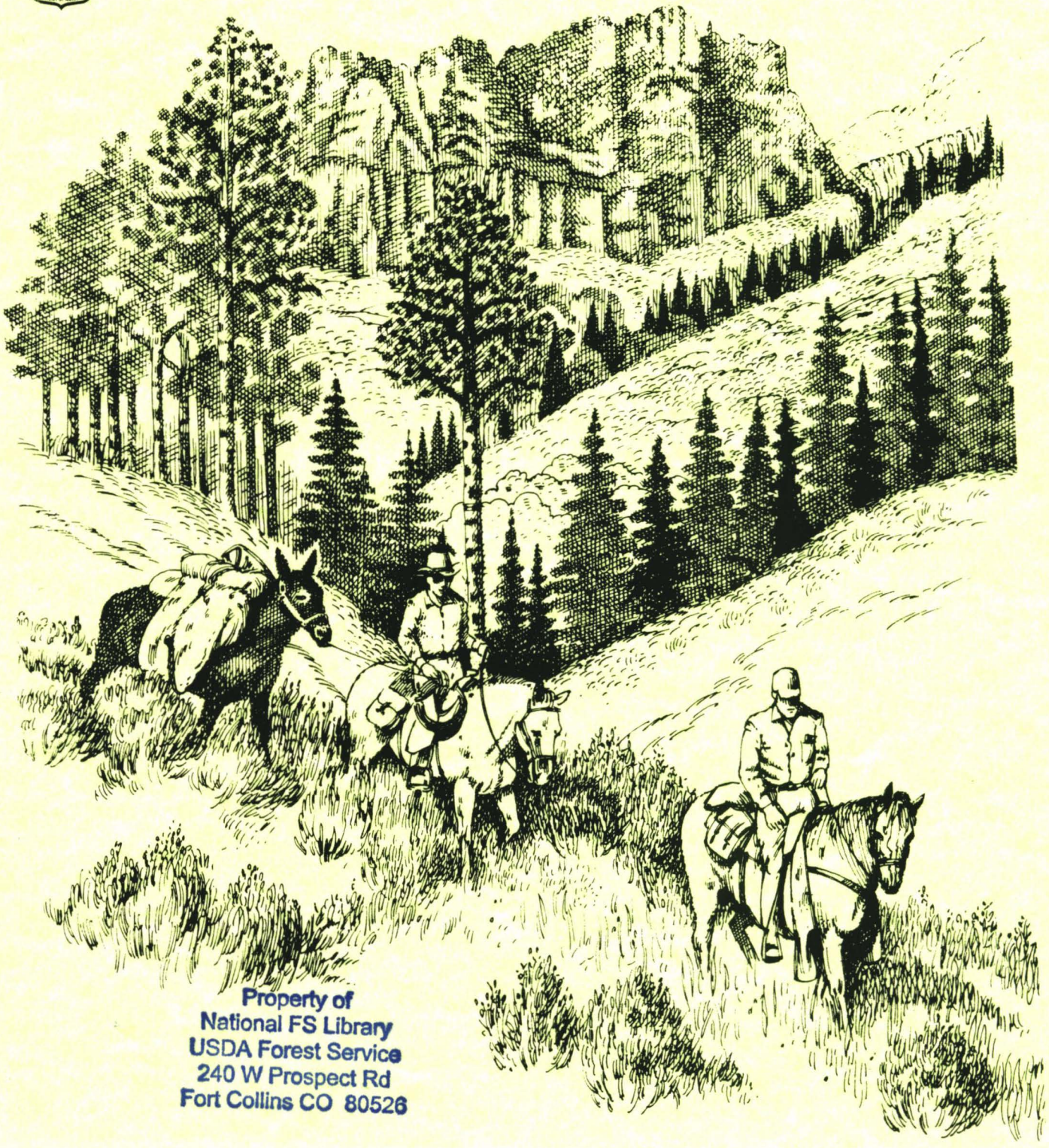
Forest
Service

**Intermountain
Region**

Ogden, Utah

Jarbidge Wilderness
A Class I Airshed

Air Resource Management Program
Humboldt National Forest
Elko, Nevada



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JARBIDGE WILDERNESS

MANDATORY CLASS I FEDERAL AREA

AIR RESOURCE MANAGEMENT-MONITORING PROGRAM

*****

JARBIDGE RANGER DISTRICT

HUMBOLDT NATIONAL FOREST

Approval recommended _____ 5 March 87
Roderick Howard
Jarbidge District Ranger
Date

Approval recommended _____ 4/10/87
B.J. Graves
Humboldt NF Supervisor
Date

Approved _____ 5/4/87
for Stan Tixier
Regional Forester
Date

Table of Contents

Preface.....p. 1

Scope.....p. 2

Objectives.....p. 3

Acknowledgements.....p. 4

Summary.....p. 5

Introduction.....p. 7

Issues.....p. 9

The Jarbidge Wilderness.....p. 10

Wilderness Air Resource Policy.....p. 12

Jarbidge Wilderness Air Resource Management Assumptions.....p. 14

Air Quality Related Values.....p. 15

Wilderness Fire Management.....p. 19

Action Plan.....p. 20

Implementation Costs.....p. 23

Air Management Cooperators.....p. 24

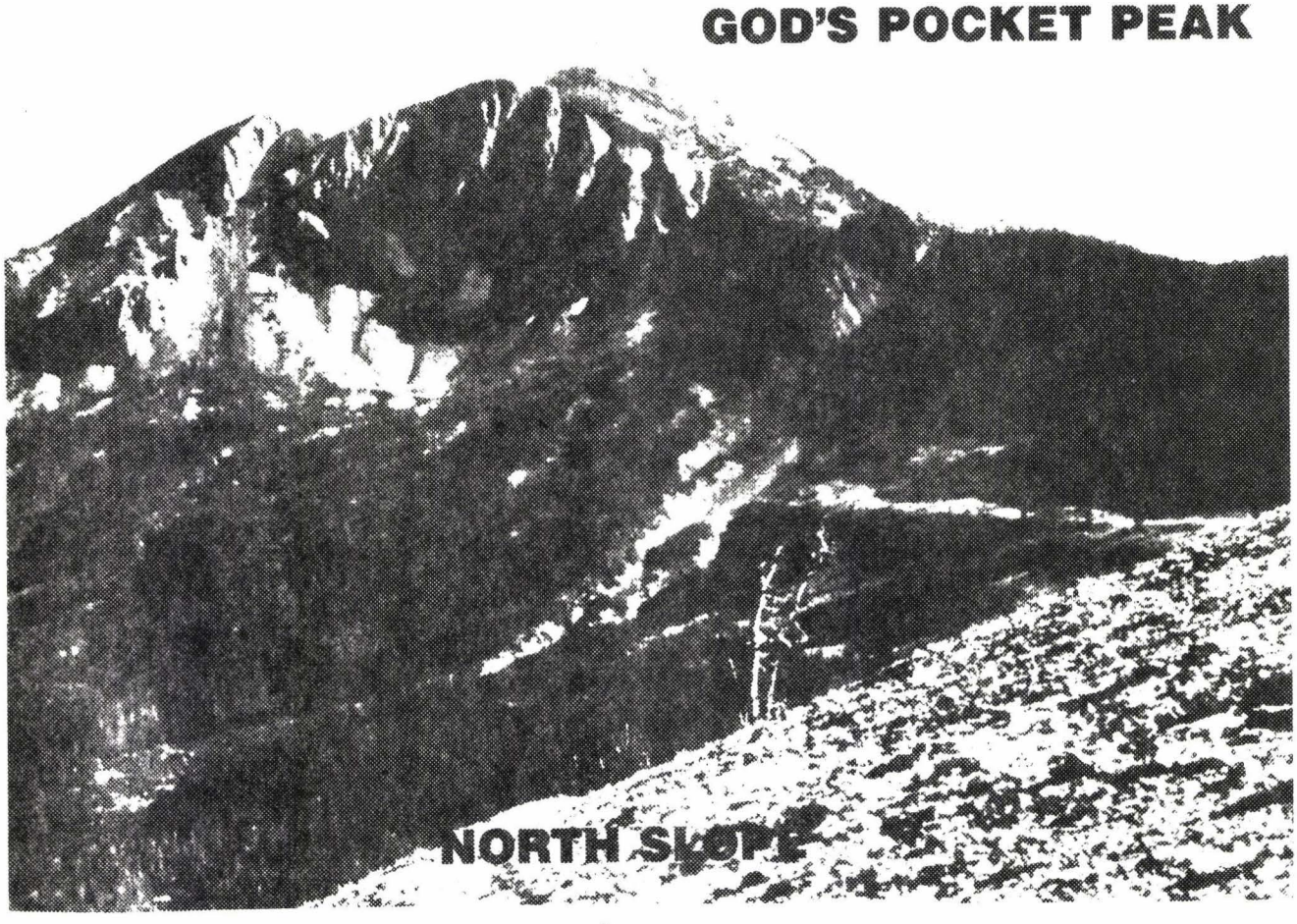
Appendix.....p. 24

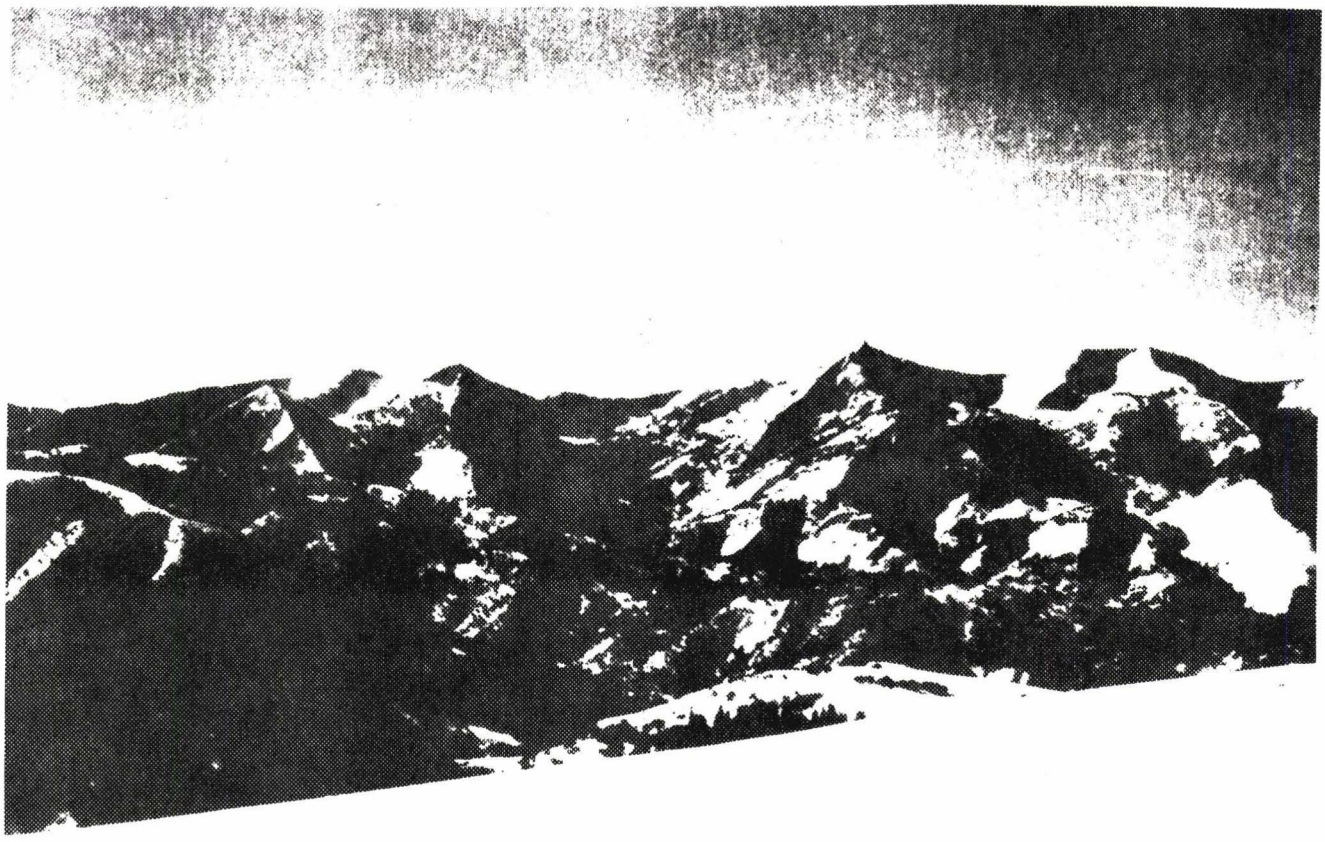
Preface

The Humboldt National Forest of northeastern Nevada includes the high mountains and deep glaciated canyons of the Jarbidge Wilderness. This extremely rugged and scenic area has eight peaks over 10,000 feet elevation with precipitous slopes into narrow canyon bottoms 3,000 feet below. The bright and varied colors of vegetation, soil, and rock provide spectacular scenery while remoteness and difficult access over rough roads and trails provide excellent opportunities for complete solitude. This 64,667 acre wilderness contains the Jarbidge Mountain Range, the East Fork of the Jarbidge River, the upper Mary's River, and the headwaters of Camp and Cottonwood Creeks.

It was designated a Wild Area on April 9, 1958 and made a Wilderness Area by the Wilderness Act of Sept. 3, 1964. It remains the only Wilderness Area and Class I Mandatory air quality area in the State of Nevada. The 20,000 acres of adjacent areas in Fox, Goat, and Cottonwood-Camp Creeks are proposed wilderness additions.

The Jarbidge Wilderness was designated a Mandatory Class I air quality area by the 1977 Clean Air Act. The Secretary of Agriculture through the Chief of the USDA-Forest Service has delegated the Regional Forester the responsible official with authority to implement the Clean Air Act as the "Federal Land Manager" (FLM). This authority and responsibility cannot be redelegated.





JARBIDGE WILDERNESS

Scope

This air quality program specifies Forest Service management of the Jarbidge Wilderness mandatory Class I area. The goals are to meet the air resource objectives outlined in the Humboldt National Forest Management Plan; meet national visibility protection goals of the 1977 Clean Air Act; comply with the Nevada Air Quality State Implementation Plan; and carry out Forest Service Policy outlined in Forest Service Manual 2120 (Air Resource Management) and 2323 (Wilderness Management).

Objectives

The objectives of the Jarbidge Air Quality Management Program are to fulfill the Regional Forester's responsibilities as the designated Federal Land Manager under the 1977 Clean Air Act. These responsibilities are stated in the Humboldt National Forest Land Management Plan as:

1. Affirmatively protect the Class I air quality values.

2. Review and respond to Prevention of Significant Deterioration (PSD) air quality permit proposals.

3. Comply with Federal and State air quality regulations.

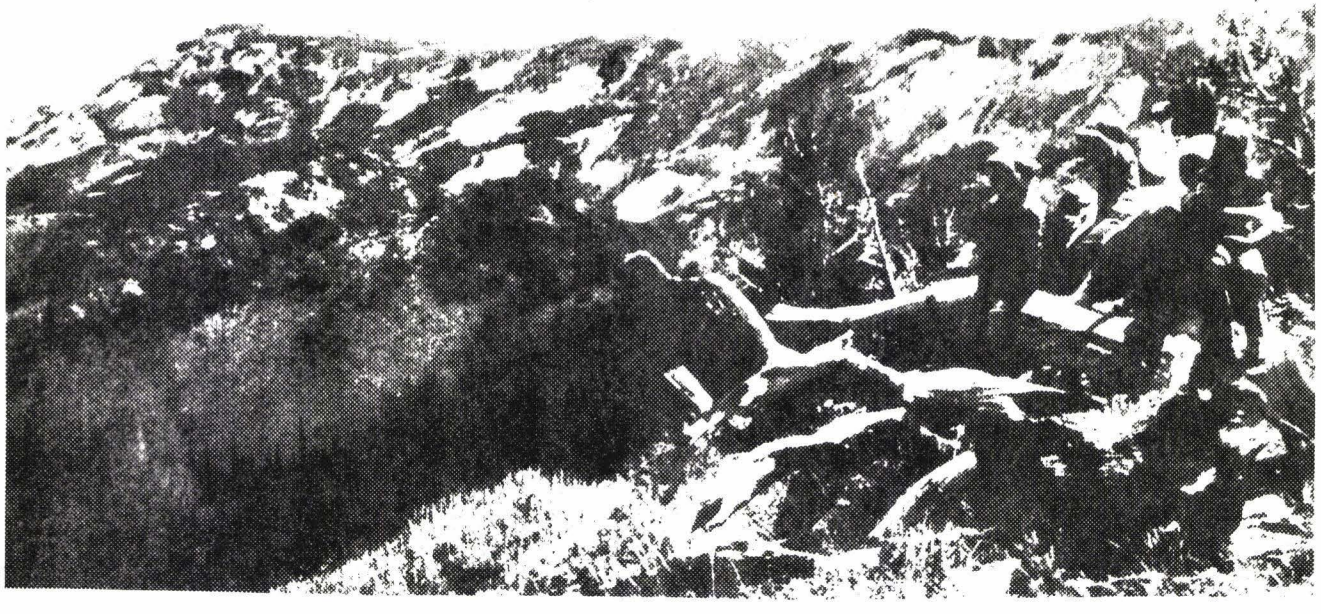
4. Determine Air Quality Related Values (AQRV), identify sensitive receptors, and determine Limits of Acceptable Change (LAC).

5. Monitor sensitive receptors.

6. Cooperate with Federal, State, and local agencies.

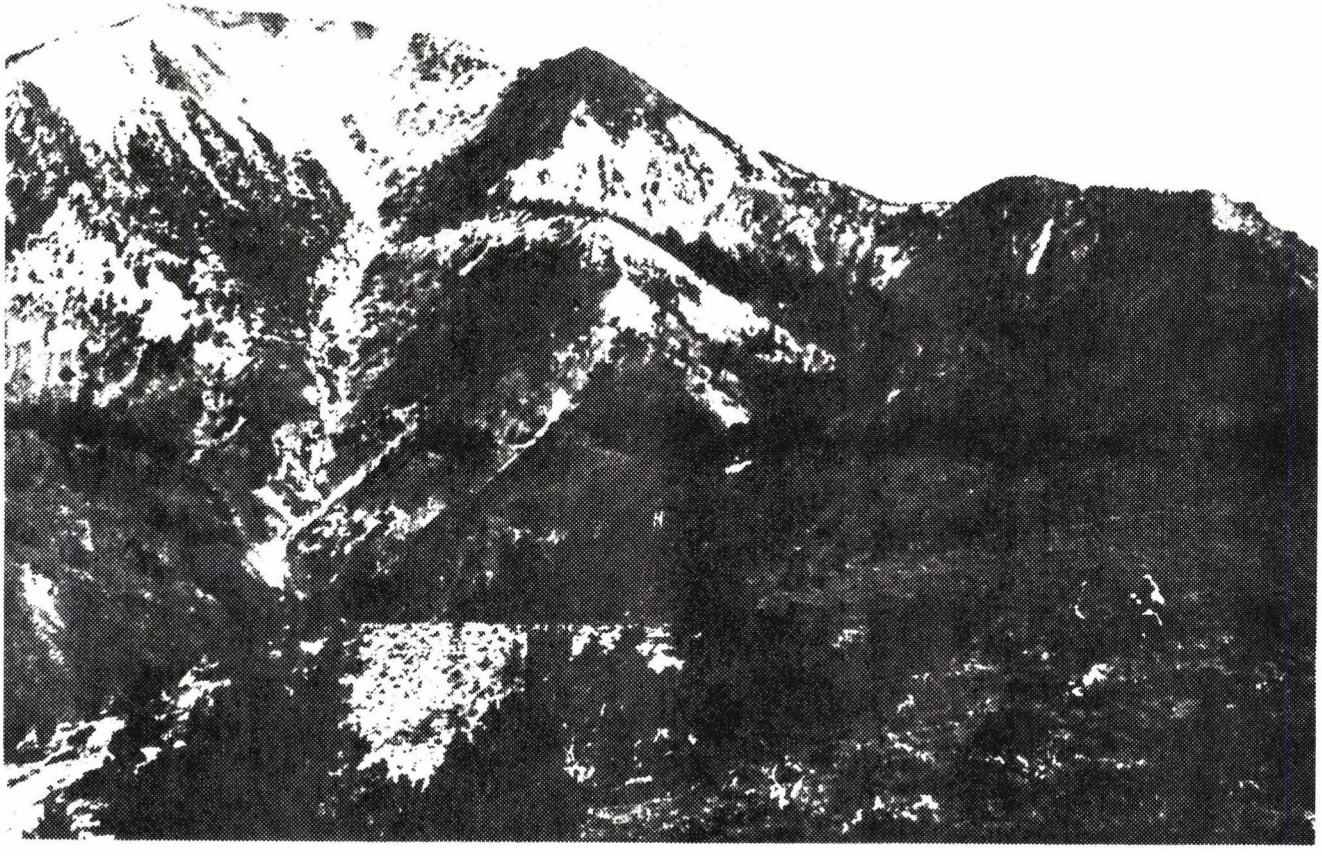
7. Determine adverse impacts of air pollution sources.

JARBIDGE WILDERNESS - EAST TOWARDS HUMMINGBIRD SPRINGS



Acknowledgements

This Air Resource Program and Action Plan was developed by Clif Benoit, Region 4 Air Quality Officer, and John Caywood, Jarbidge Ranger District Resource Assistant in response to the 1977 Clean Air Act, Forest Service Direction, and the Humboldt National Forest Plan. Essential assistance in the program formulation, development, and implementation was provided by: Gay McCleary and Lowell Schifley Jr. of the Nevada Air Quality Bureau, Humboldt National Forest Supervisor B.J. Graves, Air Resource Branch Chief Walt Hanks, Jarbidge District Ranger Robert Easton, and Bonnie Whalen, Humboldt National Forest Dispatcher.



GOD'S POCKET PEAK - SOUTH SLOPE

Summary

Following are the key findings, conclusions, and recommendations that surfaced during the development of this area program and action plan.

A. Findings

1. Visual range within and around the Jarbidge Mandatory Class I area has been progressively degraded since 1940 in proportion to development in the western United States.

2. Acid deposition is suspected in the Jarbidge Wilderness. Acid precipitation (4.6 pH) has been measured at Craters of the Moon National Monument 125 miles northeast of the Jarbidge Wilderness. Great Basin National Park 175 miles southeast of the Jarbidge has also documented the occurrence of acid precipitation.

3. Emerald Lake in the Jarbidge Wilderness is susceptible and sensitive to acid deposition.

4. Acid deposition precursors are increasing rapidly in this air region due to long range westerly wind transport. This is particularly true of nitrous oxides (NOx).

5. The Jarbidge Wilderness/Class I area represents an area containing the nation's last remnant of nearly pristine air.

6. The Jarbidge Wilderness' Air Quality Related Value (AQRV) data base must be quantified to support air quality permit approval, mitigation, or rejection.

B. Conclusions

1. There is a need to inventory and monitor Jarbidge AQRV's to establish baseline conditions and trends.

2. There is a continuing need to coordinate Jarbidge air resource management activities with the Nevada Air Quality Bureau.

3. A detailed air resource action plan with specific costs needs to be developed and implemented.

4. Identified air resource management activities to comply with the Forest Plan need to be budgeted.

5. Cooperation needs to be initiated and maintained with agencies doing similar air quality work (National Park Service at Craters of the Moon National Monument, Great Basin National Park, Bridger-Teton National Forest, Idaho National Engineering Laboratory, Soil Conservation Service snow surveys, and Forest Service Research branch).

C. Recommendations

1. An inventory of Jarbidge streams, lakes, and lichens as chemistry sensitive receptors needs to be accomplished by 1989.

2. Establish on-Forest air resource baseline monitoring points and/or collaborate with and use existing data collected at Great Basin National Park, Craters of the Moon, and/or SCS snow surveys, etc. within the 1987-1992 period.

3. Quantify sensitive receptors; such as lake alkalinity, visibility, lichen chemistry, and soil pH.

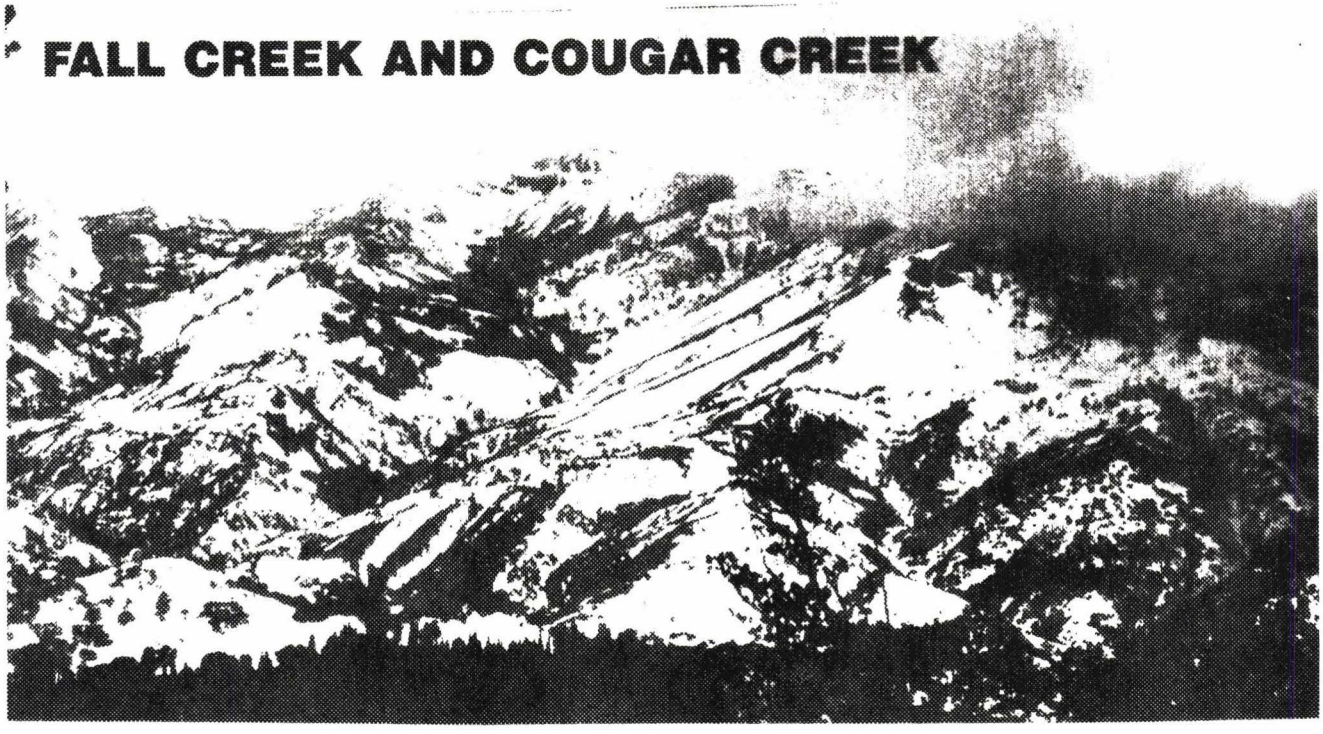
4. Determine AQRV and baseline LAC for sensitive receptors by 1990. Provide sensitivity data to the Nevada Air Quality Section annually as processed.

5. Develop and maintain an air quality management data file including an AQRV data management system in DG.

6. Continue to operate the national Interagency Monitoring to Protect the Visual Environment (IMPROVE) visibility and fine particulate monitoring site at the wilderness boundary. Incorporate the data into the management of the Jarbidge Wilderness and provide an annual summary to State of Nevada.

7. Determine acid deposition occurrence within the wilderness using snow core analysis and bulk precipitation collector techniques. Results will be coordinated with the Bridger Class I Wilderness AQRV program and the State of Nevada.

FALL CREEK AND COUGAR CREEK



Introduction

The Forest Service has specific air resource management responsibilities in the Jarbidge Wilderness mandated by law, regulation, and policy. The essential tasks associated with implementing this policy in Forest Service Region 4 are to establish baseline AQRV's, including visibility, determine LAC, monitor air quality impacts on 1.3 million acres of Class I and 3.3 million acres of Class II Wildernesses, and make recommendations to the states on applications for Prevention of Significant Deterioration (PSD) and air quality regulation permits.

The Nevada Air Quality Regulatory Agency manages and enforces air resource increment consumption through engineering evaluations of air pollution sources' ability to meet specific numerical air pollution levels. New source air pollution permit application decisions are based on two factors -- increments and adverse impacts to AQRV's. An increment is an additional amount of air pollution above the Federal Land Manager's (FLM's) determined baseline concentration. Most effective FLM input to the state/Federal Environmental Protection Agency (EPA) air quality permit process must be based on documented AQRV baseline inventories. Thus, the Forest Service must evaluate potential air quality effects on the full range of wilderness values (vegetation, wildlife, visibility, soil, water, etc.). It must also identify the most sensitive receptors and their limits of acceptable change (LAC). This is a very complex process.

Until there is sufficient baseline AQRV data to statistically define the air pollution effects found in the Jarbidge Class I area, the FLM has defined the LAC for AQRV's to be a measureable change from the present condition. When the Region has sufficient information and programs to assure adequate AQRV and Wilderness protection from specific air pollution impacts, the LAC may be modified to account for natural variations and tolerance of the ecosystems. Measureable change is limited to one-tenth (.1) of a pH unit, five percent (5%) visibility change, and five kilograms per hectare (5 kg/ha) of depositional sulfate.

The Humboldt National Forest is ranked sixth in air resource management workload of the sixteen National Forests in Region 4. The Jarbidge Wilderness contains Emerald Lake, which is quite sensitive to acid deposition. Jarbidge Lake, just outside the wilderness, is extremely sensitive to acid deposition. The Jarbidge Ranger District burns a yearly average of 300 acres of sagebrush near the Wilderness.

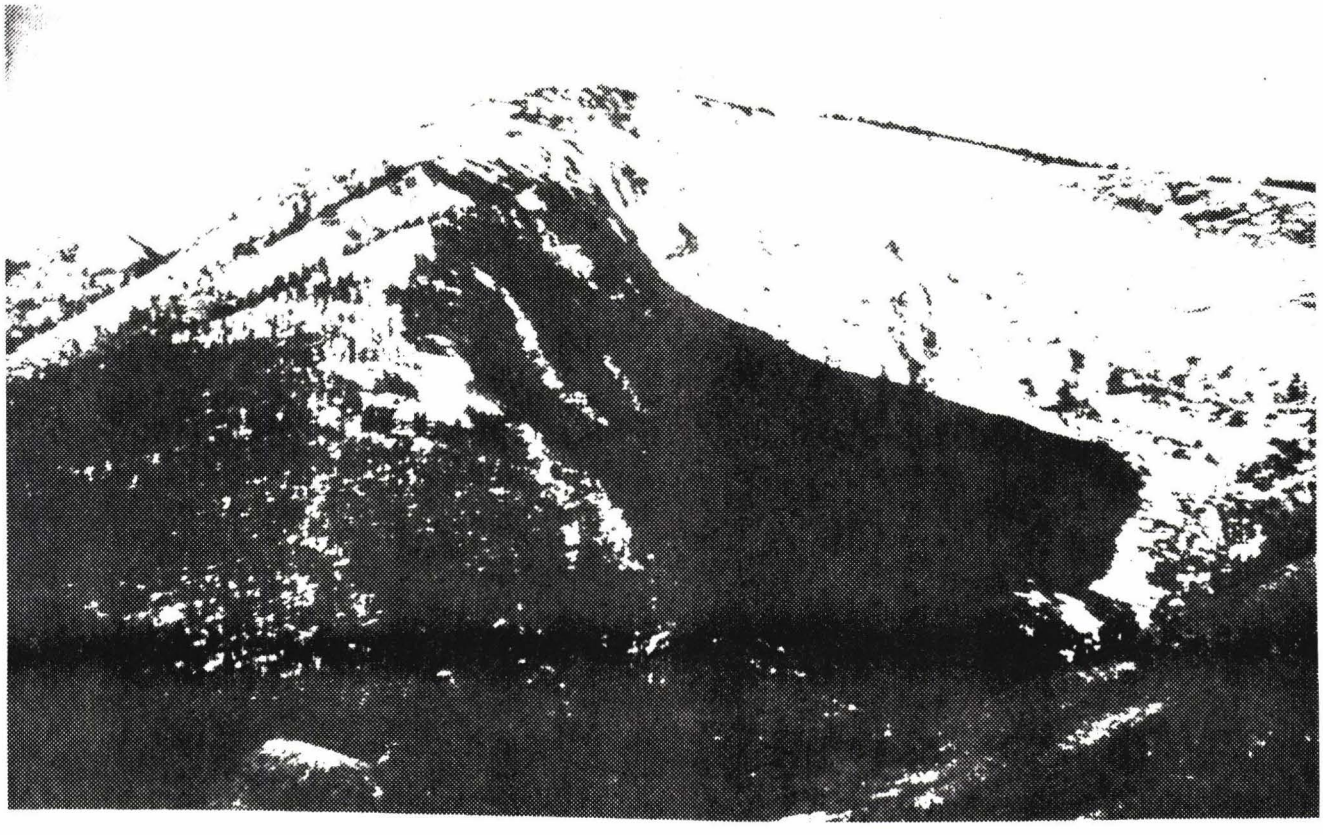
Additionally, the Environmental Protection Agency, in response to an Environmental Defense Fund lawsuit, has established a national visibility monitoring network called Interagency Monitoring of Protected Visual Environments (IMPROVE). Representatives from the Forest Service, Bureau of Land Management, EPA, Fish & Wildlife Service, and the National Park Service as Federal Land Managers have the responsibility to plan, participate in, and oversee this longterm EPA/FLM cooperative visibility monitoring network.

The initial IMPROVE program will monitor visibility parameters at 20 Class I areas across the country. Five of the sites are Wildernesses managed by the

Forest Service. The Jarbidge and Bridger Wildernesses in Region 4 are part of this national network. IMPROVE monitoring sites were selected from 156 Mandatory Class I areas in which visibility was an important value. Five selection criteria (anticipated visibility change, scenic sensitivity and value, existing visibility problems, representativeness of other visibility protected areas, and geographic distribution) were used. The 64,667 acre Jarbidge Wilderness was selected because it represents the center of a region which has the least visibility impairment in the United States. It is also the only congressionally mandated Class I area in Nevada.

IMPROVE monitoring instruments will be located outside the Wildernesses looking in. They will monitor radiance, fine particulates, and utilize time-lapse photographs. A battery powered time-lapse camera is taking three pictures of the wilderness per day at 0900, 1200, and 1500 hours. Particle samples in different size ranges will be collected continuously from line powered equipment. Atmospheric opacity will be measured continuously from a line powered transmissometer.

IMPROVE data will be used to evaluate existing visibility and trends in mandatory Federal Class I areas, control anthropogenic sources contributing to the significant impairment of visibility in Class I areas, and help make decisions about visibility impacts from proposed new sources on Class I areas. The data will also be used to identify atmospheric constituents causing visibility degradation and their relative importance to individual vistas in Class I areas. Inclusion of the Jarbidge Wilderness in the national IMPROVE program has accelerated Forest Service need to establish cost effective, Regional visibility trends. Recent EPA promulgation of standards for particulate matter smaller than 10 microns (pm<10) as well as state regulation under federally approved implementation plans will impact federal smoke management activity and require better baseline visibility AQRV data.



Issues

Air resource management issues in the Jarbidge Wilderness Mandatory Class I area are:

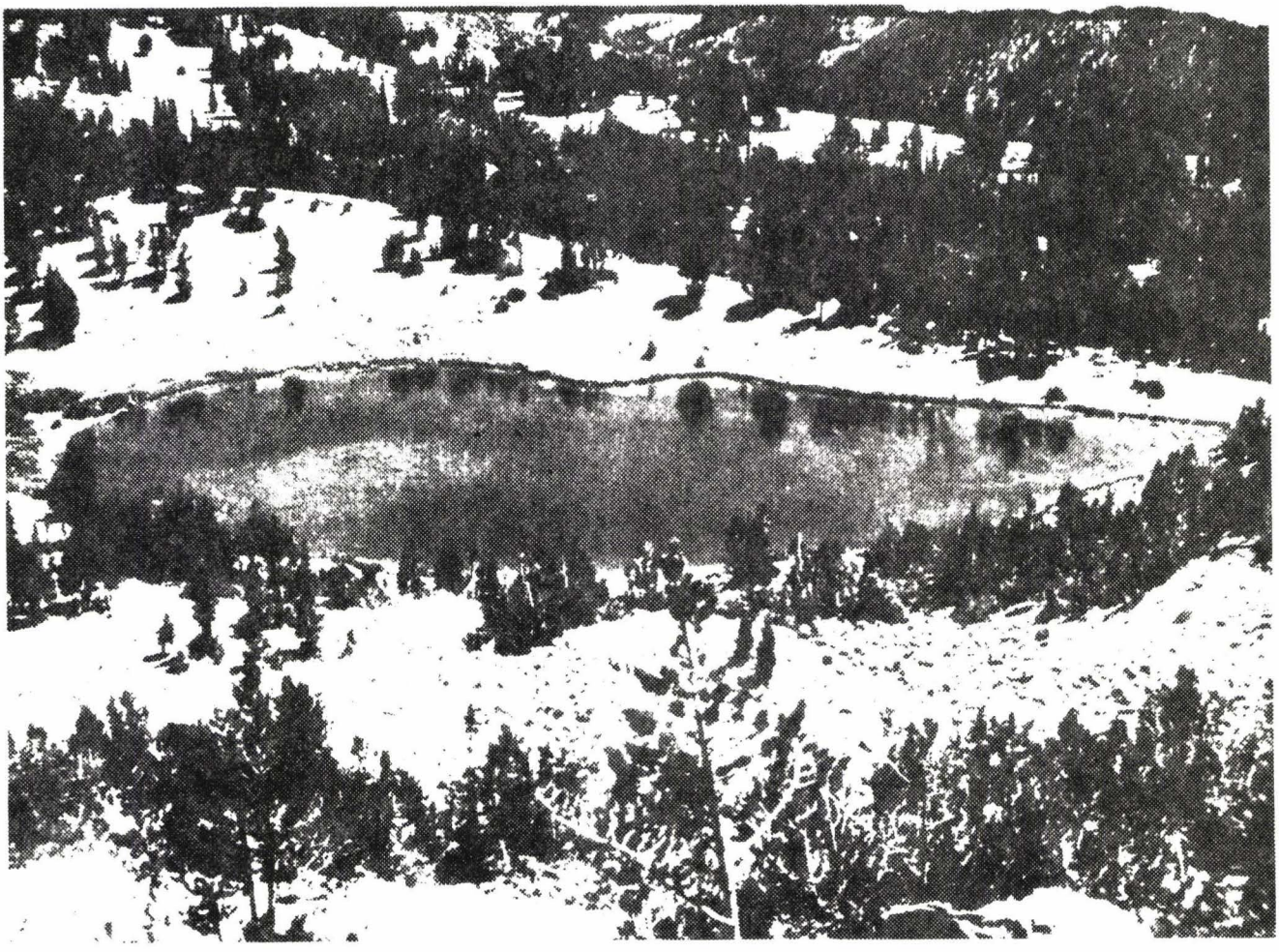
1. Increasing man-caused visibility degradation.

2. Low alkaline, acid sensitive Emerald Lake is receiving acid deposition.

3. Emerging major air pollution proposals which could impact the area.

4. Urgent need to statistically inventory and define LAC for all AQRV's.

5. Growing concern for cumulative effects of the many, new, small air pollution sources not requiring PSD actions.



EMERALD LAKE

The Jarbidge Wilderness

The Jarbidge Wilderness was established in 1964 to preserve its unique, pristine ecosystems in an untrammeled condition for the enjoyment and use of future generations. Being the only Nevada wilderness, it typifies the uniqueness of the Great Basin physiographic province's "Islands in the Sky" as its high mountain ranges are so often called. This description aptly fits these ranges as they unexpectedly soar from surrounding 6000 foot valley floors to peaks almost a mile above.

This is a multiple use wilderness. Mining activity, grazing, water production, hunting, fishing, and recreation occur in the wilderness. The northern part of the wilderness has numerous valid gold claims. The Mary's River and Hummingbird Springs areas are grazed by domestic livestock. Waters from the Mary's River are used to irrigate hay meadows on the downstream ranches. Trout are present in Emerald lake and the larger streams. Lahontan cutthroat trout, a federally listed threatened species, is found in the Mary's River drainage. Hunters come from all over the west to hunt mule deer in the Jarbidge Wilderness. A few California bighorn sheep are present and more will be transplanted into this area. Most recreation use is on the northern part of the wilderness. Backpackers and horseback riders concentrate in the Jarbidge River drainages with their two alpine lakes. In the fall deer hunting season, hunters frequent most of the wilderness with particular use by the licensed outfitters.

Several vistas extend from the Jarbidge Wilderness. The most scenic vista is northward across the Snake River plain from the Jarbidge River drainage. Bennett Mountain, 100 miles to the northwest, can be seen with an eastward panorama to the Pioneer Range 122 miles away. Vistas both east and west from the wilderness are across broad desert valleys over lesser mountain ranges. The southward vista toward the Ruby Mountains is also very spectacular. The snow flecked peaks 50 miles away give a sense of scale to this hauntingly vast and seemingly empty region.

Air pollution influences on the Jarbidge Class I area are numerous. Major long range transport pollution sources to the west are industrial and agricultural areas in California, Oregon, and Washington. The Boise Valley contributes a great deal of air pollution which usually passes eastward along the Snake River Plain north of the wilderness. Occasional east winds bring the Salt Lake metroplex's air pollutants to the wilderness. PSD permitted activities more locally include the Valmy coal fired power plant and the numerous mining related sources in northern Nevada. The Jarbidge Ranger District burns an average of 300 acres of sagebrush per year north and east of the wilderness. Summer wildfires throughout the great basin and the Snake River drainage cause several weeks of visibility impairment annually. Timber slash burning in Oregon, Washington, and central Idaho also degrades visibility for several weeks each fall in and around the Jarbidge Class I area.

Specific nearby point source pollutant sources affecting the Jarbidge Wilderness are boilers, land disturbances, conveyors, furnaces, carbon ore plants, ore crushers, concrete batch plants, incinerators. Operators of these

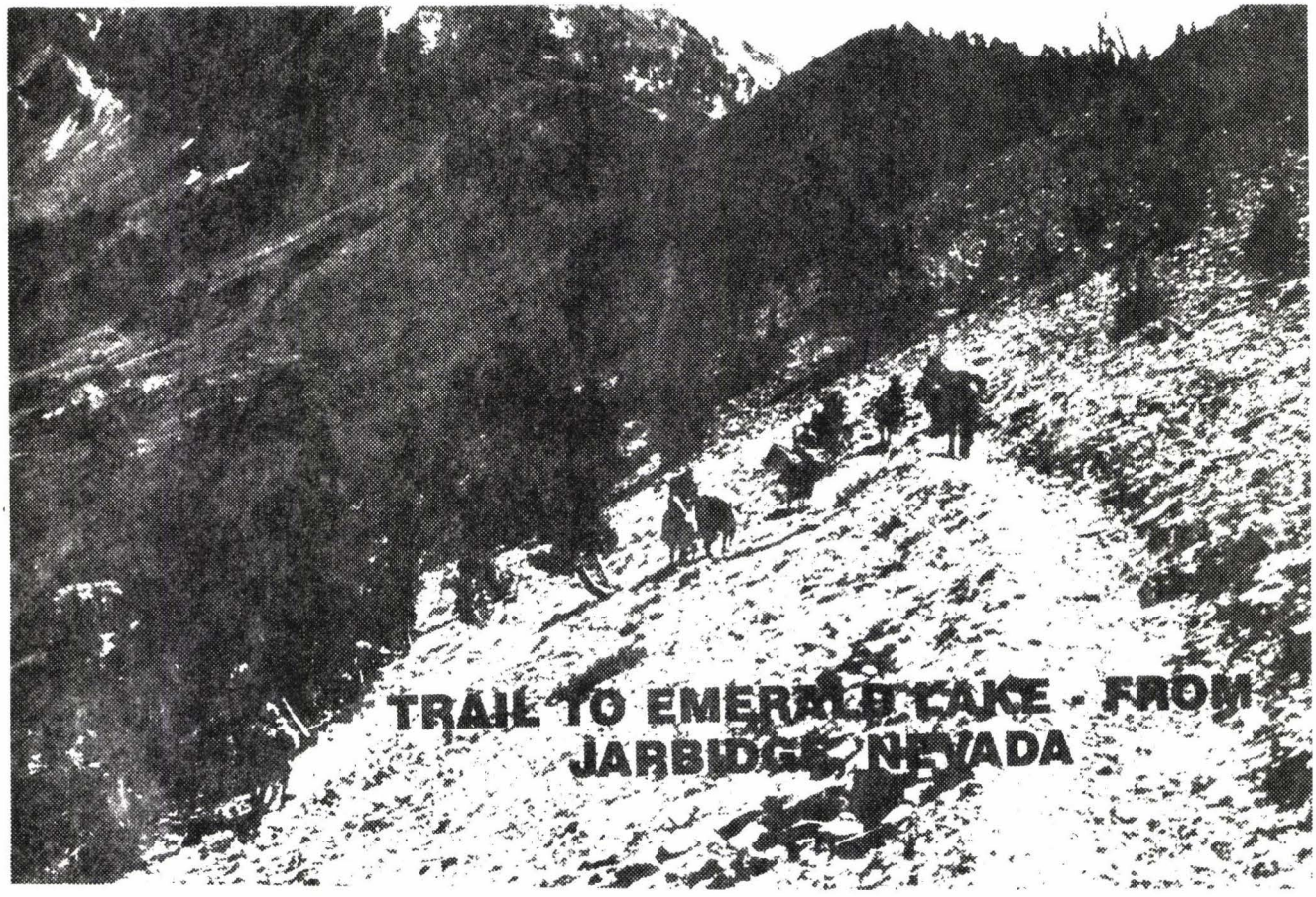
activities are Circle A Construction, Freeport Gold, J Equipment, and the Owyhee Hospital.

Potential future impacts to the Jarbidge wilderness area are the proposed Sierra Pacific Power & Light coal fired generating plant north of Wells (40 miles east) and the White Pine Power Plant north of Ely (130 miles southeast).

The Jarbidge Wilderness is particulary vulnerable to acid deposition. A 1986 water sample showed Emerald Lake to have an alkalinity of 131 ueq/l putting it in the low end of sensitivity. A sample from Jarbidge Lake, just outside the wilderness, had an alkalinity of 35 ueq/l classifying it as ultrasensitive to acid deposition.

Visibility in and around the Jarbidge wilderness is deteriorating. Longtime residents of Jarbidge remember clear views of the Pioneer Mountains 122 miles north of the wilderness being common. Today clear views are much less frequent and highly cherished. Terrestrial and aquatic trends have not been determined. National Park Service and other data shows downward trends nationwide at stations within 200 miles of the Jarbidge.

There are no known federally listed threatened or endangered plant species in the Jarbidge Wilderness. During August of 1987 the Regional botanist will conduct a plant assessment of the wilderness to further determine presence or absence of threatened or endangered plants. The Lahontan cutthroat trout, a federally listed threatened fish species, is present in the Mary's River drainage of the Jarbidge Wilderness.



Wilderness Air Resource Policy

National Forest wildernesses are managed under the authority of the 1964 Wilderness Act. Those established prior to the Clean Air Act amendments of August 1977 are Mandatory Class I areas. Wildernesses established after that date are Class II areas. The Wilderness Act charges the Forest Service with protection of National Forest System Wildernesses from any man-caused degradations not specifically allowed by law. It allows action to be taken against sources of air pollution affecting a wilderness but probably only after an effect has occurred.

The statutes specifically providing for pre-emptive protection of visibility from industrial pollution are the Clean Air Act Amendments of 1977. In this Act, Congress set aside certain international parks, national wilderness areas, national memorial parks, and national parks as mandatory Class I federal air quality areas for present and future generations to enjoy. The Jarbidge Wilderness is one of these Class I areas. In these areas, existing pollution affecting visibility is to be remedied and future pollution prevented.

Section 165 of the Act requires visibility protection in preconstruction review of Prevention of Significant Degradation (PSD) permit applications. It gives Federal Land Managers of the Class I areas the "affirmative responsibility" to protect visibility and other air quality related values. It also requires the states in their State Air Quality Implementation Plans (SIP's) and the EPA to consider the recommendations of the FLM. Section 165 thus authorizes Federal Land Managers to recommend to state and federal licensing agencies before licensing.

If a Class I PSD increment is predicted to be exceeded, the permit applicant may attempt to demonstrate to the satisfaction of the FLM that no AQRV will be adversely affected. Conversely, if the increment is not exceeded and the FLM feels the AQRV will be adversely affected, he is obligated to recommend permit denial. This shift of the "burden of proof" is an important distinction which emphasizes the importance of good baseline AQRV data.

Section 169A required the Environmental Protection Agency (EPA) to develop implementation regulations and guidelines to the states for their State Implementation Plans. On December 2, 1980, EPA published these in the Federal Register (Volume 45, No. 233, p. 80084). These:

1. Require control of visibility impairment of mandatory Class I Federal areas that can be traced to an existing facility or small group of facilities.

2. Require evaluation and control of new air pollution sources to prevent future impairment in Federal Class I areas.

3. Require states to adopt strategies to remedy existing and prevent future visibility impairment.

4. Give States the discretion to extend visibility protection to views from within Class I areas of outside landmarks or panoramas. The States determine how much, if any, protection to afford these "integral vistas".

Forest Service Manual section 2120 provides direction in air resource matters. Forest Service Manual 2323.62 provides wilderness air resource management direction. Wilderness air resource management policy is to define AQRV's, select and monitor sensitive indicators, determine Limits of Acceptable Change (LAC), make recommendations to PSD permit reviews, and manage smoke from prescribed fires so as to least affect AQRV's of Class I areas. The Forest Service's Wilderness Management Five Year Action Program recommends that Limits of Acceptable Change be integral components of Wilderness Management Plans and that air quality threats be identified.

The Humboldt National Forest Land Management Plan (p. II-24) establishes air resource management objectives for the Jarbidge Wilderness of:

1. Affirmatively protect AQRV's including visibility and effects of atmospheric deposition.

2. Recommending PSD permit actions to the State of Nevada.

3. Complying with Federal and State air quality regulations.

4. Determining AQRV's, identifying sensitive receptors, and LAC.

5. Monitoring sensitive receptors.

6. Cooperating with Federal, State, and local air quality regulatory agencies.

7. Determining adverse impacts.

The Regional Forester, as the Clean Air Act delegated FLM, has the responsibility to implement the 1977 Clean Air Act and State Implementation Plans on 1.3 million acres of Class I and 30 million acres of Class II National Forest land in Region 4. Among these responsibilities are consideration of air quality in all management activities, participation with states in the formulation of air resource regulations and standards, and conducting air resource management studies.

The Humboldt National Forest Supervisor is responsible to the Regional Forester to take action to prevent air quality impacts to the Humboldt National Forest. This air quality management program specifies his responsibilities to establish and protect AQRV's in this Class I area, inventory AQRV's, establish and monitor sensitive receptors, recommend LAC for sensitive receptors, assist the Regional Air Quality Officer, and perform other activities.

Jarbidge Wilderness Air Resource Management Assumptions

This air quality management-monitoring program assumes that:

1. Public scrutiny of Forest Service air resource management activities will expand.

2. Existing and potential air pollution impacts to the Jarbidge wilderness will increase.

   a. The number and type of PSD activities will increase.

   b. Surface waters of the Jarbidge Wilderness will remain very susceptible to acid deposition.

   c. Visibility will continue to be impacted by uncontrolled, long range pollution transport.

3. Human use and appreciation of the wilderness will increase.

4. Implementation of air resource management will be necessary.

5. The superior visual range, often exceeding 150 miles, within and around the Jarbidge Wilderness will gain importance as a national treasure.

6. Public concern for threatened and endangered plant and animal species in wilderness will increase.

Air Quality Related Values

While visibility is the only air quality related value identified in the Clean Air Act, an AQRV can be any value of an area --- such as visibility, vegetation, water chemistry, or odor --- that may be affected by air quality. Jarbidge Wilderness AQRV's include flora, fauna, soil, water, cultural, geologic, odor, and visibility. Flora and fauna may be affected by changes in growth, mortality, reproduction, diversity, visible injury, succession, and productivity. Soils may experience changes in cation exchange capacity, base saturation, pH, structure, and metals concentrations. Water may change in pH, total alkalinity, metal concentrations, and anion/cation concentrations. Visibility contrast, visual range, and coloration may be affected. Cultural and archaeologic decomposition rates may change.

Limited funds and staff prevent immediate inventory and monitoring of all AQRV's. The Bridger-Teton National Forest's monitoring program to establish baseline AQRV's cost $400,000 over two and one-half years. Even then, it had not produced sufficient information for regulatory purposes. Nonetheless, once baseline air resource data is established, the limits of acceptable change (LAC) will be identified for each wilderness AQRV. Any measured or predicted change beyond the identified LAC for each AQRV sensitive receptor shall be considered adverse.

AQRV sensitive receptors are those AQRV's that are measureably affected by changes in air quality. By monitoring these sensitive receptors, the Forest Service can detect impacts of changing air quality, estimate effects of proposed PSD sources, and use them as indicators of effects on non-monitored, less sensitive AQRV's. Jarbidge Wilderness sensitive receptors will be:

1. Lake alkalinity
2. Visibility-fine particulates
3. Lichens

Lake alkalinity: The Jarbidge Wilderness is vulnerable to acid deposition. Emerald Lake is particularly sensitive to acid deposition. Baseline lake alkalinity will be established by recurrent sampling.

Much publicized Scandinavian research data probably applies to the Jarbidge. The thin soils and sparse vegetation of high elevation watersheds in the western United States suggest a high sensitivity to acid deposition. Data from six western states that affect Jarbidge wilderness air quality shows 1,277,000 metric tons of SO2 and 2,306,000 metric tons of NOx emitted in 1980. Measurements in Colorado and Wyoming suggest original alkalinities as low as 10-20 microequivalents (ueq) per liter in some watersheds. Thus, near term acidification thresholds in these areas can be expected to lie below 15 kilograms per hectare per year (kg/ha/yr) total sulfate deposition. In the long term, acidification may occur in alpine watersheds receiving total sulfate deposition as low as 5 kg/ha/yr.

Forest Service Region 4 Acidification Sensitivity Index is:

Alkalinity	less than 200	ueq/liter	= sensitive
" " "	" " 125	" "	= very sensitive
" " "	" " 75	" "	= ultrasensitive

A 1986 water sample showed Emerald Lake to have an alkalinity of 131 ueq/liter, putting it in the low end of sensitive. A Jarbidge Lake sample had an alkalinity of 35 ueq/liter, classifying it as ultrasensitive to acid deposition.

This low buffering capacity indicates that the aquatic ecosystems in the Jarbidge have little protection from acid deposition. A major concern for the aquatic ecosystems is possible acid shock during snowmelt. Acid material in the snow causes a freezing point depression which can result in the hydrogen ion concentration of the first melt water being 5-10 times that of the bulk snowmelt. It is also possible that the first snowmelt would have little to no interaction with the frozen soils before entering lake systems. The lake chemistry may then become the same as the initial snowmelt chemistry for a short time. One primary concern is the long-term effect of acid deposition on the watershed's longterm buffering capacity. Biotic changes to lake ecosystems caused by pH changes may occur in reproduction, growth, mortality, and species diversity of plankton, macroinvertebrates, and fish.

Visibility: Visibility is the most detectable AQRV to the general public. It is commonly referred to as the relative ease with which objects can be seen through the atmosphere under various conditions. Visibility impairment is the major air resource management issue in the western United States. There are generally two types of air pollution which reduce or impair visibility:

(1) Smoke, dust, colored gas plumes, or layered haze emitted from stacks which obscure the sky or horizon and are relatable to a single source or a small group of sources, and,

(2) widespread, regionally homogeneous haze from a multitude of sources which impairs visibility in every direction over a large area.

These types of pollution are caused by factories, plants, and other sources that emit particles and gases into the air. These substances either absorb or scatter the light, thus reducing the amount of light a person can receive from a viewed object. The practical affect is that impaired visibility degrades the aesthetic value of surrounding landscape by (1) discoloring the atmosphere to produce a visible plume, (2) whitening the horizon and causing objects to appear flattened so that landscape colors and textures become less discernible, or (3) in the case of a discernible plume, obscuring some portion of the landscape.

Jarbidge Wilderness sight distance is decreasing as witnessed by long time residents. The primary means of determining baseline visibility will be from the IMPROVE monitoring site results.

Most of the light scatter, and thus visibility impairment, is due to fine particulate matter concentrated in the .2 to 1.0 micron size. Common particle

types which scatter light are ammonium sulfate, soil, soot, and remaining fine mass such as sulfur dioxide (SO2) and oxides of nitrogen (NOx).

National Park Service (NPS) particulate samples were taken from 1982 through 1985 at Craters of the Moon and Lehman Caves National Monuments as well as other NPS sites nationwide. They showed regionally representative patterns of fine particulate matter. These studies indicate that average fine particulate mass less than 2.5 um varied from less than 3 ug/m3 in parts of the western U.S. to over 10 ug/m3 in the east. Average fine mass was lowest in the California-Oregon border area just west of the Jarbidge Wilderness. The Jarbidge Wilderness' fine sulfur concentration was from one-tenth to one-sixth of the eastern United States. Seasonal fine sulfur was highest in the spring and summer and lowest in the fall. Regional fine and coarse soil concentrations were highest in the summer. Fine nonsoil potassium, obtained by subtracting the soil component using the iron concentration and related to wildland burning, seasonally increases in the west every June. The western sites had only 38% of the nationwide average fine particulate mass. Soot carbon component varied from 5% in the east to 10% in the west.

Smoke causes major visibility degradation due to its very efficient light scattering particle sizes. Ninety percent of smoke particulate matter from brush disposal and prescribed fire is in the less than 10 micron critical light scatter size class. Burning in the vicinity of the Jarbidge Wilderness will require implementation of improved smoke management techniques by the natural resource professional.

Integral vistas are areas outside Class I areas which are integral to and seen from points within Class I areas. The integral vista concept additionally limits the development of visibility impairing activities outside Class I areas by legally expanding the area of management concern. The State of Utah recently adopted the Secretary of Interior's 17 proposed integral vistas as State regulated vistas. Should the State of Nevada adopt Jarbidge Wilderness integral vistas as part of its Air Quality Implementation Plan, Forest Service responsibilities will increase due to its policy of complying with State Air Quality Implementation Plans.

Lichens: Lichens have long been used as bioindicators of air pollution. Lichens are a symbiotic association between algae and fungi. They are quite possibly the plant group most sensitive to air pollution. They have no root system, receiving all nutrients from the air. Having no excretion systems, they may retain and concentrate atmospheric materials. This makes chemical analysis of lichens a valuable indicator of atmospheric pollutants. Additionally, airborne acids will cause lichen chlorosis, phaeophytin formation, or plasmolysis due to sensitivity of the algae symbiont to thallus damage. The varying sensitivity of different lichen species to air pollution and their long life span (100+ years) make then an ideal sensitive receptor for this study.

The Humboldt has accepted a proposal from Dr. Larry St.Clair of the Brigham Young University Botany Dept. to implement a cooperative program to monitor lichens as sensitive receptors. Dr. St. Clair's work will establish a transect from the Jarbidge Wilderness Class I area to the Salt Lake City nonattainment area then downwind across the High Uinta Wilderness to the Colorado border. Specific work undertaken in the Jarbidge Wilderness will be a lichen floristic

survey, species identification, determination of sensitive receptor species, establishing trend plots in colonies of sensitive receptors, and chemical-biological analysis of selected lichen species. Lichen analysis will study chlorophyll A, membrane structure, and elemental quantification to include copper, lead, and sulfur.

HEAD OF COTTONWOOD CREEK

Wilderness Fire Management

Humboldt National Forest records show the Jarbidge Wilderness experiencing an average of one fire per year with almost all being less than one acre in size. During the 1970 decade there were four detected wildfires in the Jarbidge Wilderness. Two fires were lightning caused and two were man caused. The largest fire was eight acres. A 1981 fire burned 765 acres.

Jarbidge Wilderness fire management policy is to confine all wilderness fires to less than 2,000 acres. The confinement strategy in the wilderness utilizes natural and existing man-made barriers to limit wildfire spread. Management actions are primarily surveillance, assuring that a wildfire stays within determined boundaries. This strategy has proven to be very cost effective and yet allows fire to play its natural role in the wilderness.

The Forest Fire Action Plan prescribes flexible suppression response (either confine, contain, or control) to areas surrounding the wilderness. Chosen management strategies reflect fire condition class, fire acreage, fuel types, and resource values. Flexible suppression responses were selected to minimize suppression cost and resource damage. Wildfire is a natural part of wildland ecosystems. Experience has shown its damages to be minimal and short term.

Prescribed wildland burning is practiced near the wilderness by the Forest Service, the Bureau of Land Management, and private landowners. All agency prescribed fire projects require a comprehensive burning plan. Although prescribed fire activities do not require PSD permits, burn plans contain a mandatory Smoke Management section insuring proper stewardship of the air resource. Federal agency Prescribed Fire Managers and Burn Bosses do not merely comply with standards and regulations. They look beyond compliance and exercise professional and moral judgment in carrying out their duties. As professionals, they know that central to the acceptance of prescribed fire management by state and local air quality authorities, and the public is the way they handle smoke management responsibilities. They are aided by up-to-date publications such as "Prescribed Fire Smoke Management Guide" by the National Wildfire Coordinating Group. The three basic visibility objectives they achieve in their prescribed fire activities are:

1. Identifying and avoiding smoke-sensitive areas.

2. Reducing the quantity and duration of emissions.

3. Dispersing and diluting smoke before it reaches smoke-sensitive areas.

These state of the art fire management policies may allow considerable amounts of combustion products into the Class I area. These will, however, approximate natural levels and be within LAC.

Action Plan

A. Actions taken to date to implement the Jarbidge Wilderness IMPROVE visibility monitoring program are:

1. Jarbidge District Ranger Robert Easton initially authorized and established the IMPROVE visibility monitoring program and successfully attended the Marana Arizona NARTC Interagency Air Quality Monitoring Course.

2. Bonnie Whalen, Humboldt National Forest Dispatcher, has attended the Nevada Interagency Air Quality-Smoke Management Workshop.

3. In July 1986 an interdisciplinary team consisting of Walt Hanks, Humboldt National Forest Air Branch Chief; Robert Easton, Jarbidge District Ranger; and Clif Benoit, Regional Air Resource Officer investigated the Jarbidge Wilderness area to assess conditions and identify potential air quality impacts.

   a. Water chemistry sample were collected from major streams, Emerald Lake, and the Jarbidge Lakes. They were analyzed for pH, conductivity, and alkalinity.

   b. Lichen samples were collected and analyzed to determine their potential as sensitive receptors for air pollutants.

   c. A floristic photographic survey of lichens was conducted for assessment of species, sensitivity, diversity, and potential permanent monitor plot locations.

4. In September 1986 Ranger Easton with personnel from Air Resource Specialists, the data processing contractor, installed the time-lapse camera station and began visibility monitoring. The station location selected is northeast of the wilderness in Sec. 20 T47N R61E. The camera view focus point is Mary's River Peak in the wilderness 17 miles southwesterly. Criteria used to select this site were protection from animals, potential vandalism, view of at least 15 kilometers, view of part of the wilderness, view with dark foreground and sky background, relative proximity to the Wilderness boundary, least air quality disturbance between the monitor and wilderness boundary, and accessibility. Pictures are taken daily at 0900, 1200, and 1500 from approximately April 15 to November 10. Lack of contrast when the scene is snow covered allows once daily pictures at 1200 to suffice from mid-November to mid-April.

5. Locations are being considered for installation of particulate sampling and opacity measuring devices. Tentative locations are served by the Idaho Power Company transmission line and near the town of Jarbidge, Nevada.

6. Water samples were taken from Emerald Lake, the East Fork of the Jarbidge River, and Mary's River in the fall of 1986 and sent for chemical analysis.

7. Surface snow samples were taken by the SCS snow survey crew at their Goat Creek and Pole Creek snow courses just outside the wilderness in March 1987. The Forest Service then determined sample pH.

B. Actions to be taken are:

1. Continue to operate IMPROVE visibility monitoring equipment (District)

2. Continue to take wilderness water samples from streams above 8,000 feet elevation and confirm the lake alkalinity samples collected in 1986 (District). Sample soils around lakes for baseline data in 1987 (SO).

3. Install Particulate Sampler in June, 1987. The filter will initially be changed weekly. Biweekly changing may be adequate due to this station's expected high air quality. Exposed filters will be mailed to the EPA contractor for analysis. (IMPROVE contractor and District)

4. Install the Transmissometer in June, 1987. Twice weekly alignment and checking will occur initially. Biweekly adjustment may be adequate, however. (IMPROVE contractor and District)

5. The Forest Soil Scientist will describe and do baseline analyis of soils at Jarbidge and Emerald lakes. (1987)

6. Air Resource Specialists or another contractor (ARS contract expires in 1987) will develop a statistical analysis of the visual range data from the monitor camera by week, month, and season. Intensive data from the Jarbidge Wilderness particulate monitoring program will be correlated with visual range data gathered at other, less intensive, Class I monitoring stations to assist in their air resource monitoring and management programs. (IMPROVE contractor and District, 1987-1992)

7. Input funding requests for this monitoring program into out-year District and Forest budgets. Data analysis costs will be paid by the IMPROVE program. Funding as projected in the implementation section will be updated annually to maintain cost validity. (Humboldt N.F., Air Branch Chief, 1987-1992)

8. Provide AQRV visibility data to the EPA and State of Nevada Air Quality Bureau for consideration in permit issuance. (District, 1988)

9. Pursue lichen analysis and monitoring with BYU and Dr. Larry St. Clair. Include a floristic survey, species identification, determine pollutant sensitive species, find colonies of sensitive species and

establish trend plots, and chemical and biological analysis. (District, 1987-1988)

10. Coordinate AQRV data with the Nevada Air Quality Bureau. (R.O., Regional Air Quality Officer), ongoing)

11. Establish an Air Resource Memorandum of Understanding with the Nevada Air Quality Bureau. (R.O., Regional Air Quality Officer, 1987)

12. Conduct baseline stream surveys of major tributaries using macroinvertebrates as sensitive receptors. (Ranger District 1988-1990 with assistance from Dr. Fred Mangum of the USDA FS Aquatic Ecosystem Analysis Laboratory, BYU, Provo, Utah.

Implementation Costs

The following table outlines the costs associated with meeting the FLM's Air Resource Management requirements outlined in the Clean Air Act, Forest Service Washington and Regional Office directives, the Humboldt National Forest Plan, and EPA and State of Nevada Policy and Regulations. The adequate funding of this air resource management program is essential to its successful implementation. The Jarbidge Ranger District has the highest air resource management workload on the Humboldt National Forest, which is ranked sixth in air resource management workload of the sixteen National Forests in Region 4. Emerald Lake is acid sensitive. Most of the 300 acre yearly average of Humboldt fuels treatment has been on the Jarbidge Ranger District near the Wilderness.

In recognition of this, the Region's foundation level multiresource air management program has been recommended to be $200,000, with the Humboldt's share being $13,000. This estimated funding level will allow the Humboldt National Forest to meet minimum level air management responsibilities. It will fund the one-half person year workforce to accomplish this job. The action items identified herein call for fully effective, complete air resource management of the Jarbidge Class I area, Thus, the following cost estimates include funding for more than a foundation level program.

Annual project level funding needs for the initial six year period of the Forest Plan are:

	1987	1988	1989	1990	1991	1992
Lake/stream surveys	$500	$500	$500	$500	$500	$500
Camera operation	$9000	$4000	$4000	$4500	$4500	$4500
Particulate/transmissometer operations	$1500	$5500	$5500	$6000	$6000	$6000
Lichen surveys	$1500	$500	---	---	$2000	---
District administration	$3000	$3000	$3000	$3500	$3500	$3500
S.O. Administration	$2000	$2000	$2000	$2500	$2500	$2500
Total	$17500	$15500	$15000	$17000	$18000	$16000

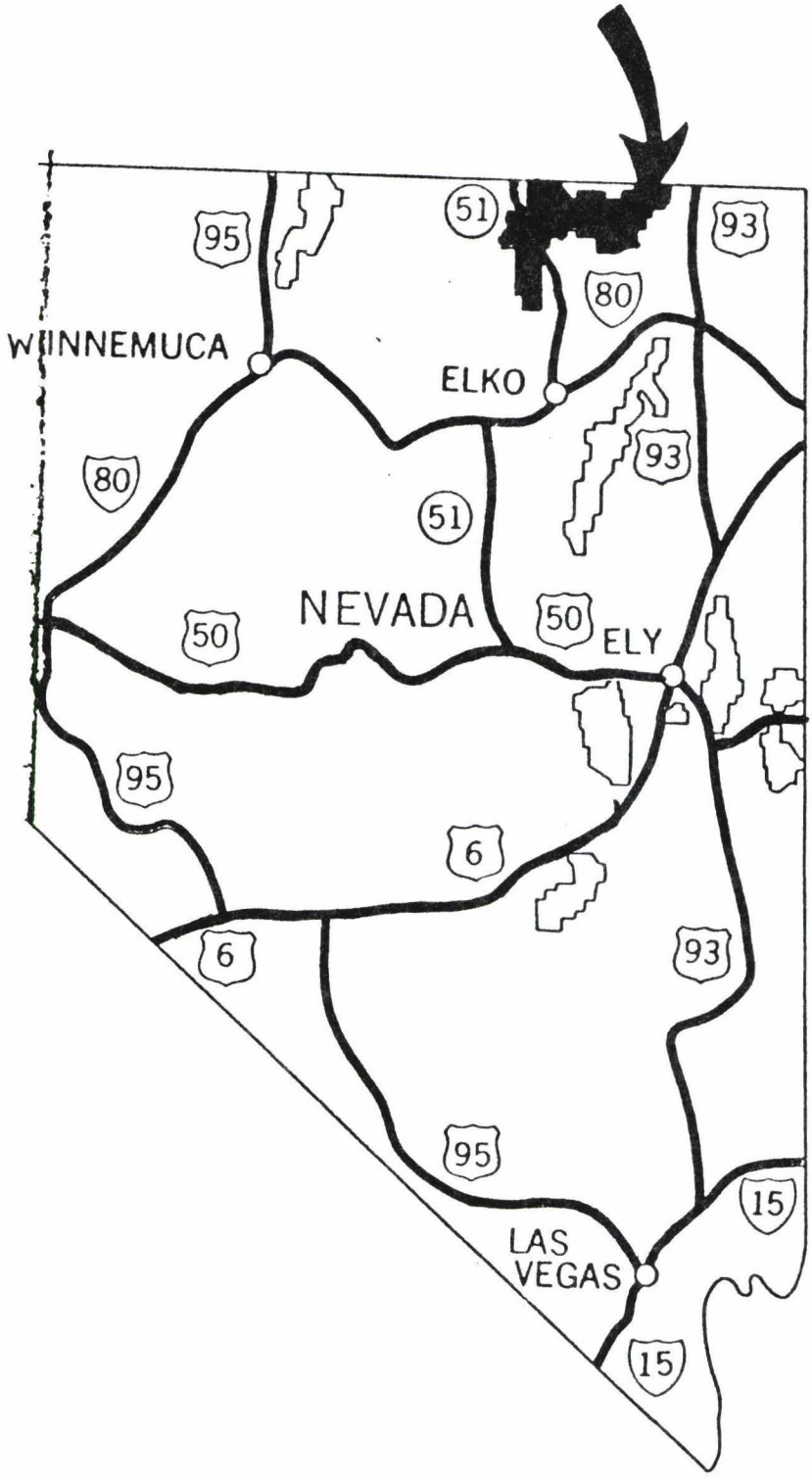
Air Resource Management Cooperators

1. Nevada Air Quality Bureau (general, PSD)
2. Idaho Dept. of Health & Welfare (general, PSD)
3. U.S.G.S. (lake chemistry)
4. Brigham Young University (lichen studies)
5. Soil Conservation Service (snow core chemistry)
6. National Park Service, Craters of the Moon & Great Basin National Park (acid rain, visibility)
7. U.S. Environmental Protection Agency (PSD)

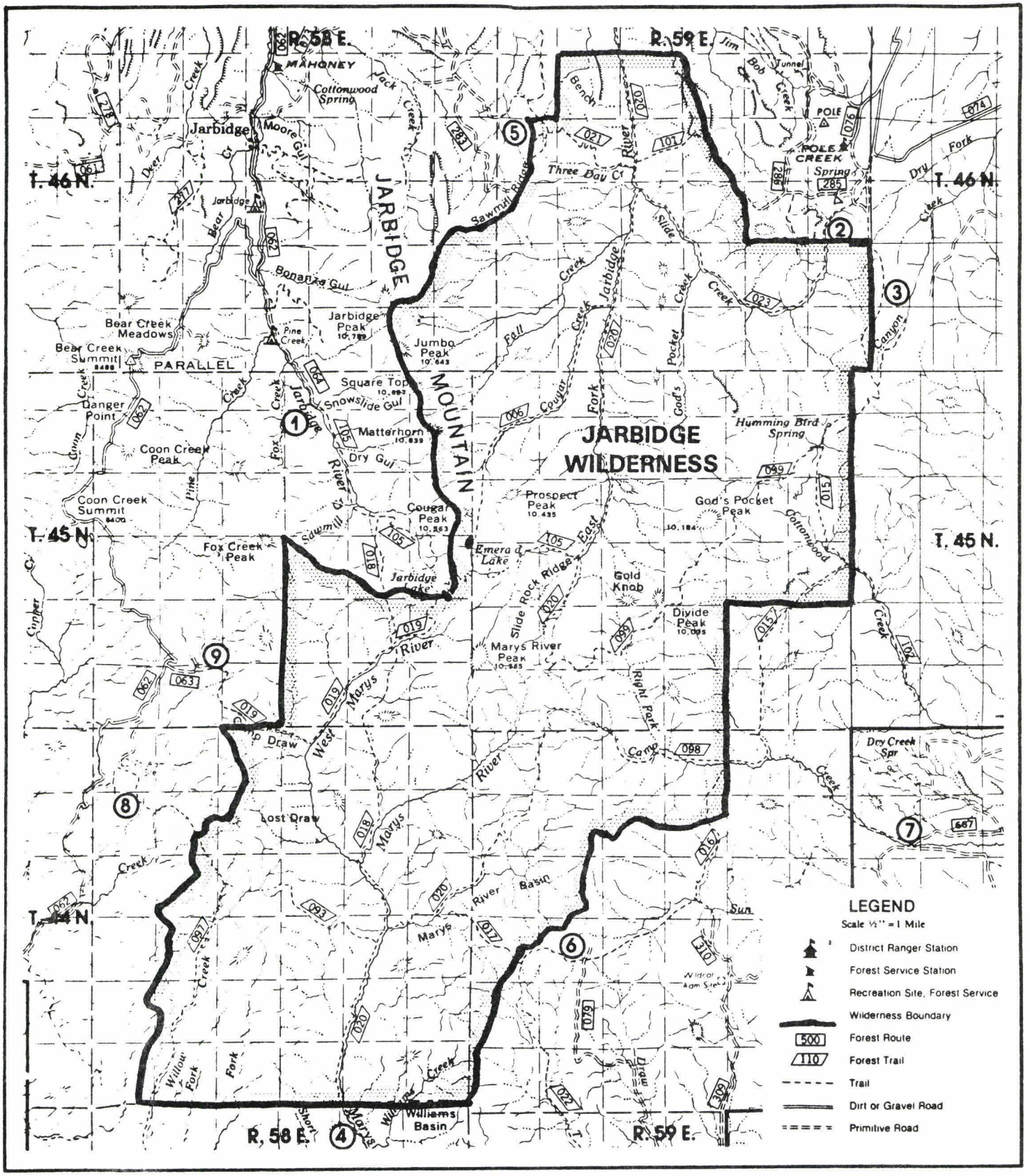
Appendix

1. Maps of Jarbidge Wilderness with monitoring site locations.
2. National Visual Range Map.
3. Visibility monitoring camera station instructions.
4. BYU lichen study proposal.

Jarbidge Mandatory Class I Federal Area



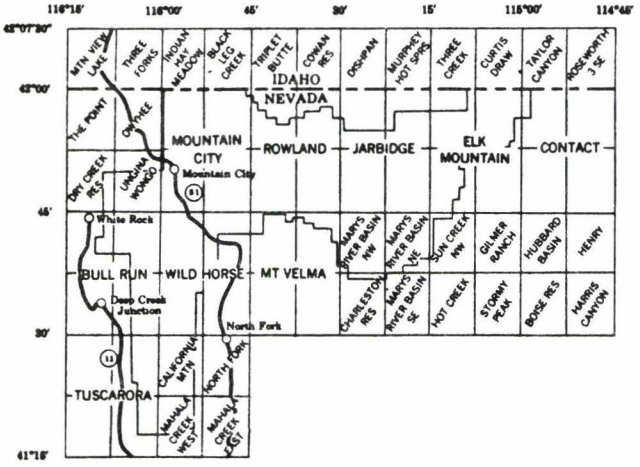
APPENDIX 1B


JARBIDGE WILDERNESS
JARBIDGE MOUNTAIN
R. 58 E.
R. 59 E.
T. 46 N.
T. 45 N.
T. 44 N.
Jarbidge
MAHONEY
Cottonwood Spring
Moore Gul
Bear Creek Meadows
Bear Creek Summit
PARALLEL
Danger Point
Coon Creek Peak
Coon Creek Summit
Fox Creek Peak
Jarbidge Peak
Jumbo Peak
Square Top
Snowslide Gul
Matterhorn
Dry Gul
Cougar Peak
Jarbidge Lake
Emera Lake
Prospect Peak
God's Pocket Peak
Humming Bird Spring
Gold Knob
Divide Peak
Marys River Peak
Slide Rock Ridge
Three Bay Cr
Sawmill Ridge
Bench
POLE CREEK
Spring
Dry Creek Spr
Lost Draw
Williams Basin
Bonanza Gul
Fall Creek
Pocket Creek
Cougar Fork
Cottonwood Creek
Right Fork Canyon
Marys River
Jarbidge River
Sawmill Creek
Dry Fork Creek
Willow Fork
Short Fork
Wildcat Aam Site
LEGEND
Scale ½" = 1 Mile
District Ranger Station
Forest Service Station
Recreation Site, Forest Service
Wilderness Boundary
Forest Route
Forest Trail
Trail
Dirt or Gravel Road
Primitive Road

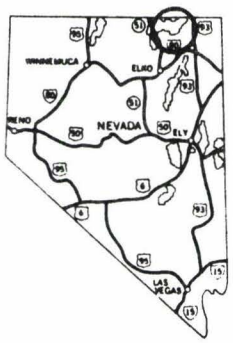
trailhead location

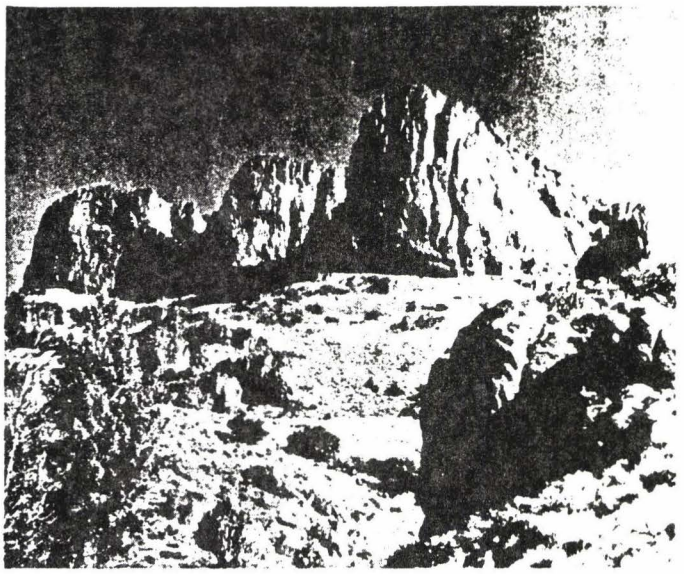
1. Snow Slide Gulch
   - Snow Slide Gulch to Emerald Lake 6 miles
2. Slide Creek Trailhead
   - Slide Creek to Cougar Creek 7 miles
3. Hummingbird Spring
   - Hummingbird Spring to Camp Creek 15 miles
4. Marys River
5. Three Day Creek Trailhead
   - Three Day Creek Trailhead to Slide Creek 9 miles
6. Draw Creek
   - Draw Creek Trailhead to Jarbidge Lake 8 miles
7. Camp Creek
8. Seventy Six
9. Camp Draw
   - Camp Draw to Slide Creek 9 miles

topographic map index



vicinity map





general information

The Jarbidge Wilderness is located near the Nevada/Idaho border, some 80 miles north of Elko, Nevada, and 70 miles southwest of Twin Falls, Idaho. The area can be reached from Nevada route S1, Idaho route S1, or US 93.

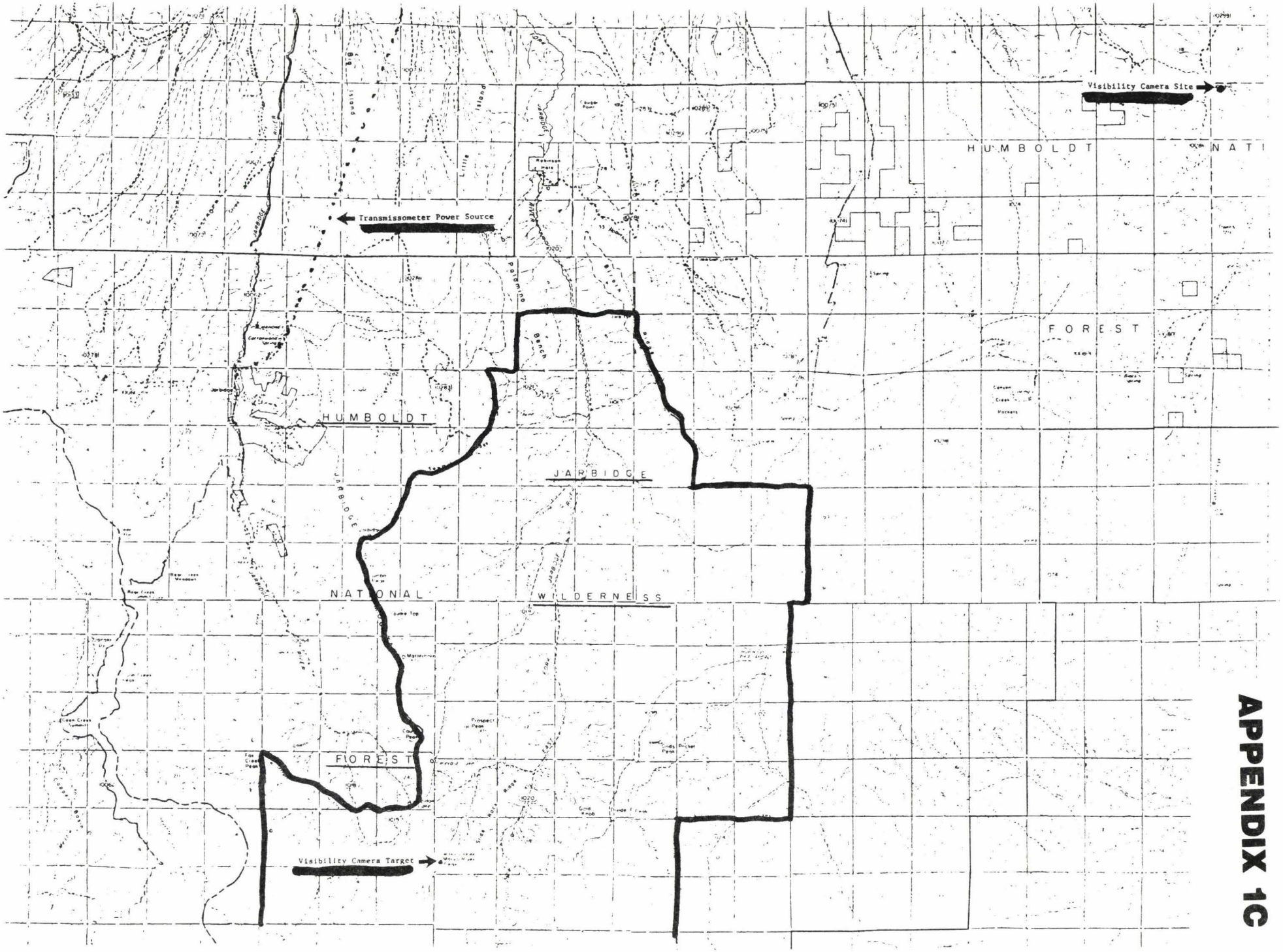
for additional information, contact the following offices:

Jarbidge Ranger District
1008 Burley Ave.
P.O. Box 508
Buhl, Idaho 83316
Phone — (208) 543-4129

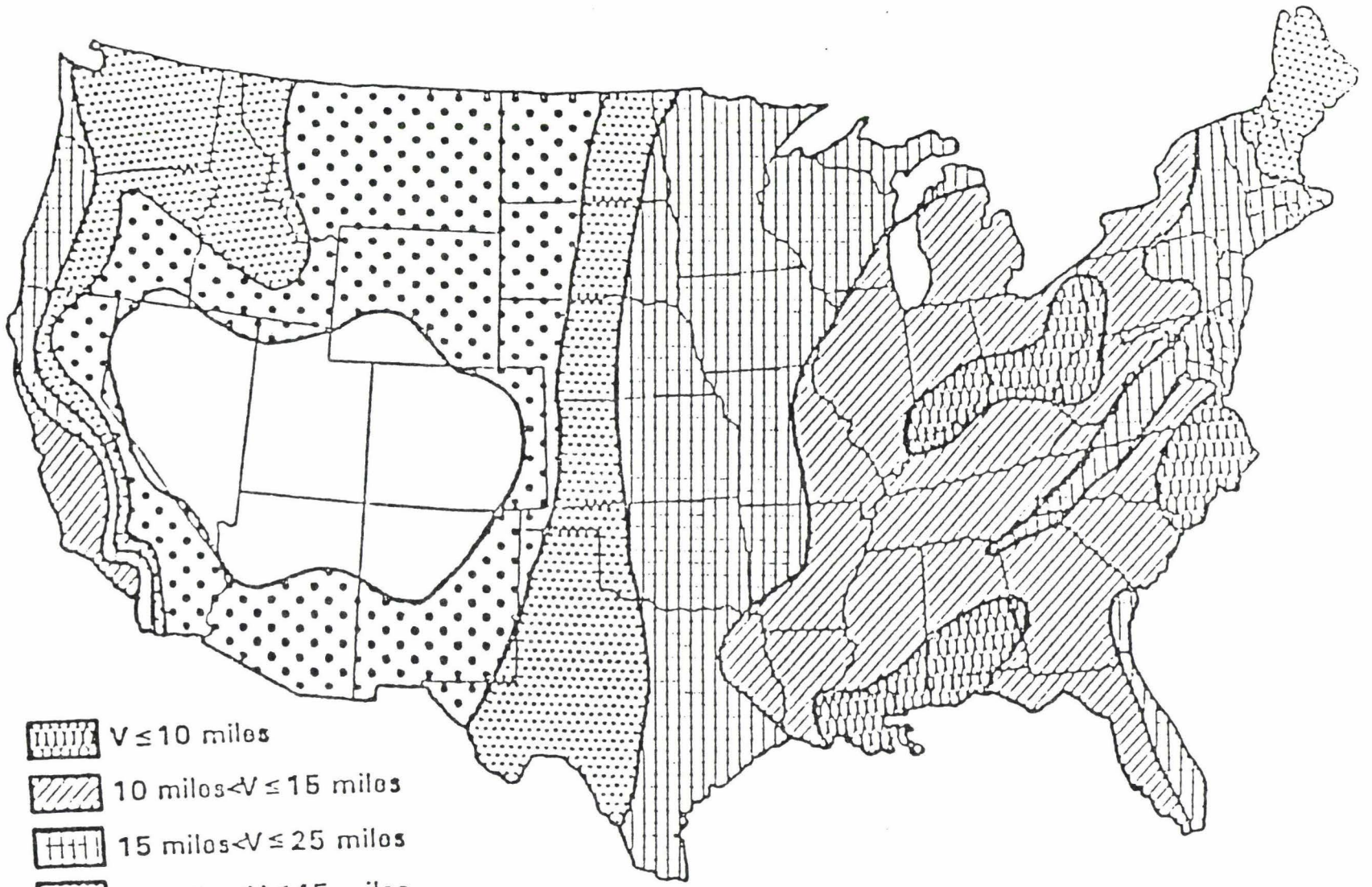
Forest Supervisor
Humboldt National Forest
976 Mountain City Highway
Elko, Nevada 89801
Phone — (702) 738-5171

during summer months:

Pole Creek Ranger Station on the east side and Mahoney Ranger Station on the west side of the wilderness are occupied by district personnel.


Visibility Camera Site
HUMBOLDT
NATI
Transmissometer Power Source
FOREST
HUMBOLDT
JARBIDGE
NATIONAL
WILDERNESS
FOREST
Visibility Camera Target

APPENDIX 1C



Urban and Rural Visibilities in the United States. (from Trijonis and Shapland, 1979)
Data Source - FAA Airport
Adjustments By: C. Benoi

C-07

APPENDIX 2

MULTITIMER™

The MULTITIMER is a programmable electronic timer manufactured by Remote Photographic Systems, Inc. (RPS.) The battery powered MULTITIMER provides up to 96 contact closures per day* at user selected times that will trip a camera to take a picture. For example, a user may elect to take five photographs per day at 0700, 0800, 0900, 1200, and 1500.

The MULTITIMER delivered to you has been preset by RPS to the correct local time for your area. The user need only select which hours a contact closure is desired (see step C and D) in the following instructions. If the time displayed on the LCD clock needs changed or the timer needs reset for other reasons, such as after a battery change has occurred, the following reset procedures should be carried out.

* This unit is user selectable for up to 24 contact closures per day. Contact RPS to have your unit reconfigured for 48 shots per day (half-hour intervals) or 96 shots per day (15 minute intervals).

RESETTING THE MULTITIMER

Read timer directions completely before proceeding. If possible, reset the timer in the office rather than in the field. An office setting is preferred for reset as this procedure must occur both in a precise and timely manner. (Note reset can only occur at the top of the hour).

The reset procedure consists of four basic steps:

- Setting the main LCD clock.
- Synchronizing timer circuitry with the LCD clock.
- Synchronizing the 24 hour light display with the LCD clock.
- Selecting the hours for which contact closures are desired.

A. Setting the Main LCD Clock
To set the LCD clock to the correct local time:
1. Slide the SET/ALARM switch to SET/T.
2. Press the HOUR SET button once to advance one hour. Press and hold to advance the hours quickly. Release at the correct hour.
3. Press the MINUTE set button once to advance the time one minute. Press and hold to advance quickly. Release at the correct minute.
4. Slide the SET/ALARM switch to ALARM/ON.

B. Synchronizing timer circuitry with the LCD clock
procedure synchronizes the timer circuitry with the LCD display. This procedure must be performed at the top of the hour so that the contact for each selected hour will occur at the top of the hour.
1. View LCD clock.
2. As display reads top of new hour, pull toggle switch marked TIMER ARM.
3. With toggle switch pulled, simultaneously press adjacent switch marked TIMER SET.
4. Release both switches.

C. Synchronize 24 hour light display with the LCD clock
1. Press HOUR VIEW button on timer top (Note: depressing hour view button for longer than 1-2 seconds may trigger an extaneous contact closure). Lighted hour must correspond with hour display on LCD clock.
Example: Light #15 should appear during the hour 15:00 to 15:59 when hour view button is depressed.
2. To synchronize hour lights with the LCD clock time, press both the HOUR VIEW and HOUR INCREMENT buttons simultaneously. Release both buttons when correct hour is reached.

D. Selecting the hours for contact closure.
Select hours for which a contact closure is desired by moving the appropriate hour switches on the timer face to the ON position. An ON switch will initiate a contact closure at the top of the hour. For example, if contact closures (photographs) are required at 0900, 1200, and 1500 switches 9, 12, and 15 should be in the ON position.

BATTERIES

There are two types of batteries in the timer, one 9 volt transistor and four AA batteries. The Multitimer should be reset following any battery changes.

1. The 9 volt battery controls the contact closure circuitry. To change the 9 volt battery, slide open the battery compartment on the rear of the timer case. Replace with a good quality alkaline 9 volt transistor battery. This battery is expectd to last three months. When this battery fails, the LCD clock will still display the time; however, no contact closures will occur.
2. Four AA batteries power the LCD clock. To change the batteries, remove the four phillips-head screws which are accessible from the back of the timer. Remove the back cover and replace the batteries. These batteries should last approximately three months. The clock display will appear dim or go blank when these batteries are exhausted.

WIRING THE CAMERA TO THE TIMER

A four screw terminal strip is mounted on the bottom of the timer. To wire the camera to the timer, connect the lug ends of the camera remote triggering cord provided to either the two left or two right screws on the terminal strip.

The timer is capable of simultaneously triggering two cameras, one attached to the two left screws and the other attached to the two right screws.

CAMERA OPERATION – PROBLEMS

It is important to read the Contax Instruction Booklet thoroughly before operating the camera.

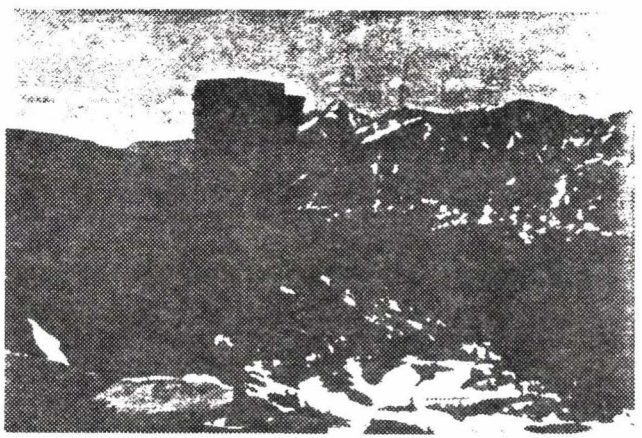
Experience has shown that the following camera and operator problems result in most of the bad photographs in the network. Page numbers refer to the pertinent section in the Contax instruction booklet.

Problems with the Camera:		Page
1.	Loading Film	28
2.	Unloading film	52
3.	Incorrect ASA setting	34
4.	Shutter speed out of range	68
5.	F-stop on improper setting	40
6.	Weak batteries	16
7.	Main lamp flashing	64

CONTACT US

if any questions or problems arise:

PHONE: Kristi Savig
Air Resource Specialists, Inc.
Fort Collins, Colorado 80525
303 224-9300



Automatic 35 mm Camera System
User's Manual

APPENDIX 3

INTRODUCTION

Photographs are a quality way to monitor visibility. Following the procedures in this manual will ensure high quality, consistent visibility monitoring.

This manual supplements, but does not replace the Contax Equipment Instruction Manuals. *Manuals for each camera component should be read and kept with your camera log book for easy reference.*

CAMERA HARDWARE

Camera: Contax 137MA Quartz
Lens: Yashica 135mm, with UV (haze) filter
Film: Kodachrome 25KM 135-36
Databack: Contax Databack Quartz D-5
Timer: 3-Clock Timer
Remote Photographic Systems, Inc.

FORMS AND SUPPLIES

The following items are necessary for continued operation of this camera system. They may, or may not, be kept at the camera location:

- Log Notebook
- Visibility Monitoring Status Assessment Sheets
- Spare Batteries:
  - 1 - 9 V Transistor
  - 4 - AA
  - 2 - 1.5 V EPX-76 silver oxide
- Padded Mailing Envelopes
- Film Cannister Labels

REGULAR MAINTENANCE

Use your Visibility Monitoring Status/Assessment Sheet every time you perform regular maintenance on the system. It is an excellent maintenance guide and can help you identify problems.

1. **Inspect** interior and exterior of cabinet for damage or other problems (water leakage, etc.). Inspect outside of camera, lens, and window for dirt.

2. **Remove camera from box.** Disconnect the timer cable from the camera. Remove the camera body by pushing the quick release lever on the tripod.

3. **Remove exposed film** from the camera, and place it in the plastic cannister supplied with the new film.
   - Fill out the label provided and attach it to the outside of the plastic cannister. The label should contain the following information:
     - Monitoring site name or abbreviation
     - Roll number
     - Date and time of first shot on roll
     - Date and time of last shot on roll

4. **Inspect film compartment** for fragments of film. Remove these by blowing lightly. DO NOT TOUCH the film guides or the shutter curtain.

5. **Load** new roll of film (see p.28 of Contax Instruction Booklet).
   - Confirm proper film advance by observing rotation of film feed indicator during film advance.

6. **Inspect camera lens** and UV filter for dirt. Clean, if necessary (see *Camera Servicing Section*).

7. **Check Camera Batteries**
   Check the batteries by moving main switch to the battery check position. Note the condition of the green lamp.

   LAMP ON – Battery voltage good
   LAMP OFF – Drained, replace batteries

   Batteries should last about a year, depending on sight conditions. Replace as required.

8. **Check Data Back** day and time.

9. **Photograph Documentation Board**
   The FIRST exposure on EVERY roll must be the documentation board on the inside of the camera shelter door. The board must contain:
   - Monitoring Site Name or Abbreviation
   - Roll Number
   - Date
   - Time
   - Grey Scale
   - Color Chart

   The board should be photographed in full, uniform lighting – no shadows or reflections.
   A. Fill the view finder of the camera with the board, allowing only a slight border between the grey scale and the edge of the frame. You may have to shift your position slightly to find a spot where there are no shadows or glare from the board. The board is mounted with velcro tabs and may be moved if proper lighting conditions are not possible with the board mounted on the box.
   B. Bring the documentation board into SHARP focus.
   C. Check shutter speed
      1. Place main switch in the ON position (**do not** place switch in AE lock position).
      2. Check shutter speed (right side of view finder) by depressing the manual shutter button slightly:

Shutter Speed	Action
1/125 to 1/1000	Take the Shot
Below 1/125	1. Set Aperture to f2.8 2. Take the shot
Above 1/1000	1. Set Aperture to f5.6 2. Take the shot

   Use manual exposure button on the camera to take this exposure.

10. **CHECK camera settings** for automatic operation:

Main Switch	Setting On
Aperture Ring	f4
ASA Dial	25
Exposure Compensation Dial	XI
Shutter Control Dial	A
Exposure Mode Selector	S

11. **Replace and Align Camera**
    A. Mount camera and tripod head onto tripod base.
    B. Check cable connection. Timer cable to left front side of camera.
    C. Look through View Finder and align camera with the vista to be photographed. *It is important that the alignment is constant from one roll of film to the next.* Check:
       - Horizon is level
       - Vista is framed the same as previous alignment
       - Sun shade is not visible in view finder

    Firmly tighten all locking levers on the tripod head, and recheck alignment.

12. **Check timer settings.** See *Clock Timer Section* if timer must be reset.

13. Complete all items on **Visibility Monitoring Status/ Assessment Sheet,** insert yellow copy of status sheet in log book.

14. Remember to bring exposed film and original copy of Visibility Monitoring Status Assessment/Sheet back for **mailing.**

15. **Close and lock** camera box.

16. **Mail film** and Visibility Monitoring Status/Assessment Sheet to:

    Air Resource Specialists, Inc.
    634 South Mason Street
    Fort Collins, Colorado 80524

    ATTN: Kristi Savig

CAMERA SERVICING

1. **Lens**
   A. Periodically check the camera lens and filter for excess dust.
   B. Use the supplied brush, lens paper, and cleaning fluid to clean lens.
   C. Unscrew the UV filter and clean the lens and inside surface of the UV filter only if necessary.
   D. Fold a piece of lens paper into a size that will clean the eye-piece. Do not use sharp objects or Q-tips to clean.
   E. Do NOT remove the lens to clean inner surfaces.

2. **Film Compartment**
   A. Before loading new roll of film, check the film compartment for fragments of film. Remove these by blowing lightly.
   B. Do NOT touch the film guides or the shutter curtain.

3. **Camera Batteries**
   A. Check the batteries by moving main switch to the battery check position. Note the condition of the green lamp

      LAMP ON – Battery voltage good
      LAMP OFF – Drained, replace batteries

   B. Batteries should last about a year.
   C. The Contax uses four AA (1.5 volt) silver oxide batteries. Check Contax Instruction Booklet (p.12) for installation instructions.

4. **Data Back Batteries**
   The Data Back D-5 uses two 1.5 volt, EPX-76 batteries. Check Contax Data Back manual for installation, and resetting instructions. Batteries should last about a year.

THREE CLOCK TIMER

The timer provides a contact closure at up to three user-selected times per day. The contact closure trips the Contax camera to take a photograph.

Three individual clocks are incorporated into the timer. Each clock displays the actual time of day, and each clock alarm is set for the desired photograph time. When the alarm time is reached, the clock alarm output trips a contact closure at the terminal strip on the bottom of the timer. In normal operation, the top clock alarm time is set for 9:00 (9:00 a.m.), the middle clock alarm time is set for 12:00 (12 noon), and the bottom clock alarm time is set for 15:00 (3:00 p.m.).

To Set the Time
1. Slide the SET/ALARM switch to SET/T.
2. Press the HOUR set button once to advance one hour. Press and hold to advance the hours quickly. Release at the correct hour.
3. Press the MINUTE set button once to advance the time one minute. Press and hold to advance quickly. Release at the correct hour.
4. Slide the SET/ALARM switch to ALARM/ON.

To Set the Alarm
1. Slide the SET/ALARM switch to SET/A. The time displayed is the time for which the alarm is presently set.
2. Press MINUTE set and/or HOUR set following the steps in "To Set the Time" to set the desired alarm time.
3. Slide the SET/ALARM switch to ALARM/ON to activate the alarm.

Batteries
There are two types of batteries in the timer, one 9 volt transistor transistor and one AA battery.
1. The 9 volt battery controls the contact closure signal to the camera. To change the 9 volt battery, slide the battery compartment on the rear of the timer case open. Replace with a good quality alkaline 9 volt transistor battery. This battery is expected to last three months. When this battery fails, the clocks will still display the time; however, no photographs will be taken.
2. One AA battery powers the three clock display. To change the battery, remove the four phillips-head screws which are accessible from the back of the timer. Remove the back cover and replace the battery observing the same polarity: the positive end goes toward the white wire. This battery should last approximately one year. The clock display will appear dim or go blank when this battery is exhausted.

BIOMONITORING OF AIR QUALITY USING SELECTED LICHEN SPECIES

by
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A PROPOSAL SUBMITTED TO THE U.S. FOREST SERVICE

FOR ESTABLISHMENT OF A BASELINE TRANSECT FROM THE JARBIDGE WILDERNESS AREA IN HUMBOLDT NATIONAL FOREST, NEVADA TO THE UINTA MOUNTAINS IN ASHLEY NATIONAL FOREST, UTAH

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PROJECT SUMMARY

This proposal contains a plan to develop an air quality biomonitoring network using elemental analyses and specific physiological properties of selected lichen species. This system will be used to establish an effective, hypersensitive biological baseline for future biomonitoring of air quality in those areas of the State of Utah where natural plant communities are most likely to be impacted by existing and future degradation of air quality. Baseline data will also be collected at a "clean air" site in northeastern Nevada in the Jarbidge Wilderness Area of Humboldt National Forest.

Lichen biomonitoring systems have been shown to provide critical data which are useful in predicting impending air pollution-related damage to major ecosytem components. This approach is based on the hypersensitivity of some lichen species to many common airborne urban and industrial contaminants. This type of system will therefore contribute substantially to state and federal efforts to effectively biomonitor changes in air quality in natural communities adjacent to major urban and industrial complexes in the State of Utah.

The system will consist of two transects. One transect will extend from the Wasatch Front, east through the mountains of northeastern Utah to the Colorado border. Study sites will be established at regular intervals along this transect. At each site concentrations of lead, sulfur and copper in the tissues of selected lichen species will be analyzed. Specific physiological properties (membrane permeability and chlorophyll content), for the same lichen species, will also be evaluated and compared for each site. A second, shorter transect will be established in the Jarbidge Wilderness Area of Humboldt National Forest in northeastern Nevada. Again concentrations of lead, sulfur and copper in tissues of selected lichen species as well as specific physiological parameters (membrane permeability and chlorophyll content) will be evaluated. Rationale for establishing the Jarbidge transect centers around the fact that the Jarbidge area has been shown to have exceptionally "good" air quality and thus the data from this transect should provide an effective benchmark for assessing existing conditions along the northeastern Utah transect.

APPENDIX 4

DETAILED PROJECT DESCRIPTION

OBJECTIVES:

The following objectives will be accomplished during the course of this project:

1. establishment of an air quality biomonitoring network for northeastern Utah using selected physiological properties of four species of lichens.
2. assessment of Pb, S and Cu levels in tissues of selected lichen species.
3. establishment of a hypersensitive biological baseline for evaluating air quality problems related to existing as well as future urban and industrial development along Utah's Wasatch front.
4. establishment of a "clean air" benchmark site in the Jarbidge Wilderness Area of Humboldt National Forest.
5. compilation of a list of the major lichen species found at each site.

EXPECTED SIGNIFICANCE:

Degradation of air quality in and around urban areas and the subsequent transport of pollutants from industrial centers to rural and even wilderness areas have resulted in significant and varied biological problems (Bormann 1982). Many air pollution related difficulties have far-reaching implications which could potentially result in serious ecological and economic repercussions (Bormann 1982).

Lichens have been shown to be hypersensitive to a wide range of airborne contaminants (Richardson and Nieboer 1981). This sensitivity to air pollutants is the primary reason for the extensive use of lichens as bioindicators of air quality (Hawksworth and Rose 1976; Sigal and Nash 1983). Recently it has been shown that physiological properties of lichens consistently provide a much earlier indication of air pollution damage than changes in either thallus morphology or community structure (Sundstrom and Hallgren 1973; Fields and St.Clair 1984a).

Development of an air quality biomonitoring network using specific physiological properties of lichens will provide invaluable baseline data concerning the effects of existing as well as future urban and industrial development along the Wasatch Front on adjacent rural and wilderness areas in northeastern Utah.

PRESENT STATE OF KNOWLEDGE IN THE FIELD:

The role of lichens as bioindicators of air quality is a well documented phenomenon (Ferry et al. 1973; Skye 1979). In situ field studies documenting the feasibility of using physiological properties of lichens to provide the earliest possible indication of air pollution-related damage to lichens have just recently been completed (St.Clair, Fields and Nakanishi in review). This project will provide additional field data concerning the implementation of extensive field biomonitoring programs using physiological properties of lichens.

DESIGN AND RATIONALE OF EXPERIMENTS TO BE UNDERTAKEN:

A transect extending from the west side of the Wasatch Mountains, adjacent to Salt Lake City, to the Utah- Colorado border will be established. Land east of Salt Lake City includes several areas which are either now designated as wilderness areas or are currently being considered for such status. Dinosaur National Monument also occurs along this transect. This project will provide information for evaluating the effects of diminished air quality, associated with urban and industrial development along the Wasatch Front, on potentially sensitive, downwind habitats. The need for monitoring air quality in these types of areas has been mandated by federal law. Therefore, establishment of this type of system could become a prototype for many other similar areas in the United States.

Transect points will be established at twenty-five mile intervals along the length of the northeast Utah transect. Both mid-elevation (2000 to 2600 m) and high- elevation (3000 to 4300 m) sites will be established in the vicinity of each transect point.

A second transect will be established in the Jarbidge area of Humboldt National Forest in northeastern Nevada. A total of three transect points will be identified and lichen material from both mid- and high-elevation sites will be evaluated. This portion of the project is designed to provide benchmark data for evaluation of current conditons as well as future comparisons. This approach will provide data concerning the

current status of selected lichen species from two critical habitat types (Oak-Maple and alpine tundra communities). At least four species from at least two different substrates will be evaluated at each site. At the mid-elevation sites the following lichen species (other species may be selected depending on availability) will be evaluated:

CORTICOLOUS SPECIES

1. Xanthoria polycarpa
2. Physcia aipolia

SAXICOLOUS SPECIES

1. Lecanora melanophthalma
2. Dermatocarpon miniatum

The following lichen species will be evaluated at high-elevation sites:

TERRICOLOUS SPECIES

1. Dactylina madreporiformis
2. Cornicularia aculeata

SAXICOLOUS SPECIES

1. Umbilicaria virginis
2. Lecanora chrysoleuca

The following physiological measurements will be made for each species from each site:

1. membrane permeability (Fields and St.Clair 1984a) and
2. chlorophyll content (St.Clair, Fields and Nakanishi in review). Each physiological test will be replicated 10 times for each species from each site.

In addition to physiological data, thallus content for Pb, S and Cu will be determined using atomic absorption spectrophotometry. Due to the fact that lichens are known to effectively accumulate airborne contaminants washed out of the air by precipitation; elemental analyses will provide useful information concerning the kinds of contaminants in the air as well as possible sources of contamination. Elemental analyses for Pb, S and Cu will be replicated five times for each species from each site.

Analysis of variance will be used to determine significant effects due to sites, species, substrates and interactions among these variables. Significant differences among means will be evaluated using the Newman-Keuls multiple comparison test.

DESCRIPTION AND CONFIRMATION OF COLLABORATION:

Dr. Rebecca Fields of American Microscan in the San Francisco area of California will collaborate with us on the chlorophyll analyses as well as the statistical analyses. Bruce Webb, supervisor of the Soil-Plant Analysis Laboratory here at BYU, will determine thallus content for lead, copper and sulfur.

LITERATURE CITED

Bormann, F. H. 1982. The effects of air pollution on the New England landscape. AMBIO 11(6):338-346.

Ferry, B. W., M. S. Baddeley and D. L. Hawksworth, eds. 1973. Air Pollution and Lichens. 389 pp. Athlone Press, London.

Fields, R. D. and L. L. St.Clair. 1984a. A comparison of methods for evaluating SO_2 impact on selected lichen species: Parmelia chlorochroa, Collema polycarpon and Lecanora muralis. The Bryologist 87(4): 297-301.

Fields, R. D. and L. L. St.Clair. 1984b. The effects of SO_2 on photosynthesis and carbohydrate transfer in the two lichens: Collema polycarpon and Parmelia chlorochroa. American Journal of Botany 71(7): 986-998.

Hawksworth, D. L. and F. Rose. 1979. Lichens as Pollution Monitors. 59 pp. Arnold Publishers Ltd., London.

Pearson, L. C. and E. Henriksson. 1981. Air pollution damage to cell membranes in lichens. II. laboratory experiments. The Bryologist 84(4): 515-520.

Richardson, D. H. S. and E. Nieboer. 1981. Lichens and air pollution monitoring. Endeavour, New Series 5(3): 127-133.

St.Clair, L. L., R. D. Fields and M. Nakanishi. An in situ field study using lichens as biomonitors of air quality. (In reveiw).

Sigal, L. L. and T. H. Nash. 1983. Lichen communities on conifers in southern California mountains: an ecological survey relative to oxidant air pollution. Ecology 64(6): 1343-1354.

Skye, E. 1979. Lichens as biological indicators of air pollution. Annual Review of Phytopathology 17: 325-341.

Sundstrom, K. R. and J. E. Hallgren. 1973. Using lichens as physiological indicators of sulfurous pollutants. AMBIO 2(1-2): 13-21.

Tomassini, F. D., P. Lavoie, K. J. Puckett, E. Nieboer and D. H. S. Richardson. 1977. The effect of time of exposure to sulphur dioxide on potassium loss and photosynthesis in the lichen, Cladina rangiferina (L.) Harm. New Phytologist 79: 147-155.